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AND

PATTERN-MAKER.

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BRITISH FOUNDRYMEN'S ASSOCIATION.

NOTICE TO MEMBERS.—The Secretary will be pleased to receive promises from any members of the above Association willing to read a paper on foundry practice, however short, at the next annual convention, which will be held at Glasgow during the August Bank Holidays, 1905, of which due notice will appear in the July number of the official organ.

F. W. FINCH,
Hon. Secretary.

The Foundry and Science.

MUCH has been said and written respecting the supposed inability of the present-day foundryman to fit himself to meet the demand for the more scientific principles which it is sought to introduce into foundry practice.

Of those foremost with their abuse none seem willing to suggest a remedy or point out a ready means of education along lines laid down by scientific and commercial advocates.

Whilst the proprietors and management of our large factories seek for a more enlightened generation of foundry foremen, it would, perhaps, be to their interest if they, at the same time, turned their attention, analytically, to the composition of their respective office forces, and seek to introduce more technical and scientific teaching and less conceit into the daily routine.

It is from this section that all reports and statistics emanate, therefore it is not sufficient that a knowledge of office routine only be obtained by the commercial or office staff, but rather that they should seek to gain a knowledge of the requirements of a foundry, and know the use of all foundry materials, stores, and tools. Let them make a special study of the ins and outs of the foundry, obtaining as far as possible a grasp of the intricacies of the trade, and the friction (often created

through ignorance) between foundry and office will be less prevalent, and the records be more perfect. Let harmony exist between the practical and commercial end of the business, and as the feeling of freemasonry grows so will the desire to acquire, accept, and impart knowledge grow, thereby will the seeds of knowledge mature and bring forth fruit to the betterment of all concerned, and those who are at present bewailing the scarcity of scientific foundrymen will have cause to rejoice that that which was lost is found.

The writer is well acquainted with a gentleman experienced alike in the practical and commercial end of a foundry business, who makes it a practice to impart his knowledge and experience to those immediately under his command.

He endeavours to make the office men interested in the inner workings of the foundry, encouraging them to ask questions. He interests himself in the aims and ambitions of the juniors, and is always ready to help in the selection of suitable scientific books for those studiously inclined.

To those in direct contact with the practical work he is always willing to listen and will spend hours with the foremen (at their request), after the ordinary day's work is done, explaining items of commercial interest.

Thus he is creating a desire on the part of the employés to enquire into and know more about the mysterious happenings met with in their daily occupation; the office and workshop are as one in their efforts to assist each other, and take a pride in so doing.

What one man can accomplish with apparent ease others can do.

QUERIES.

This department of the JOURNAL *undertakes the answering of queries in foundry practice and pattern-making. We trust our readers will afford us assistance in answering these queries so far as possible.*

"PRACTICAL MOULDER" writes: — I should like to know, through the medium of your Queries column, if any of your readers have experience of using cow-dung in either loam or sands of any kind?

* * *

SIGMA writes:—We are making a number of small brass castings, about ¼ in thick, and find great trouble in getting them to strip well, and to have a fine skin. Could you suggest any facing to prevent the metal eating into the sand, or any other means of getting out of the difficulty?

* * *

BLACKING.—Could any of your readers say how long it is since mineral blacking was first introduced to the trade. Also if it was the case that, prior to the days of mineral blacking, blackwash for dry sand and loam was mixed with wood or charcoal blacking and coke-dust, and any information as to the best mixture for making a blackwash for dry sand and loam work will be thankfully received.

* * *

ANSWER TO "CONSTANT READER."—"A Constant Reader" asks if it is possible to make as good teeth wheel patterns by machine tools, as can be made by hand? I should say, if it is not possible, it ought to be, and if the pattern-maker would just give the teeth a touch up with his hand tools after they are made from the machine, there would be little cause to grumble. But so long as they are finished off the machine with a rub over with sandpaper, and a touch of varnish, and passed on to the foundry in this condition as a finished job, the moulder will always have room for complaint.

All teeth wheel patterns, no matter how they be made, should have draughts sufficiently good to assist them out of the sand; otherwise, the moulder cannot save himself from abusing the pattern on account of the extraordinary rapping required in the drawing of patterns thus made. This is always aggravated in proportion to the time a pattern may be in the sand, and more especially is this so with teeth patterns made from unseasoned wood.

But I should like very much to hear a pattern-maker's opinion on this question, because it means much for him in these days, when we hear so much about the superiority of machine-moulded teeth wheels. Personally, I never could see the advantage a machine-made wheel has over a pattern-made one. To the writer it looks a waste of money in which no one profits, inasmuch as the cost of production is considerably greater in general, and nobody can be said to have benefited thereby.

Hence, I advocate the "pattern cast wheel," and, with the pattern made by a man who really knows the principles of pattern-making, and gives strict observance to the utility of taper, paint, and varnish (without which no teeth wheel pattern should be allowed to be put in sand), such will produce those castings at a price more favourable than it is known by any other method to the writer.—"PRACTICAL MOULDER."

A FLAT-BAR OVERHEAD RUNWAY.

MESSRS. ROWLAND PRIEST, Pulley Block Works, Cradley Heath, are putting on the market their patent flat-bar overhead runway with patent two-wheel trolley with ball bearings, which they claim to supersede all others in cheapness, efficiency, and simplicity. They state that it is entirely exempt from the faults existing in the old-fashioned girder system, with its unsatisfactory method of shunting through switches from one girder to another, with its levers, springs, cords, etc., etc., which are so susceptible to getting out of order, sometimes rendering the whole system unworkable. It is a plain, substantial system, consisting of two flat bars running parallel and edgeways one with the other, allowing sufficient space for the carriage to run between, which carriage is suspended by two rollers running side by side on the top edges of rails. The rollers are fitted with ball bearings, and are easily twisted round in a horizontal plane by a corresponding twisting of the load suspended below. This slight twist of the load operates on two guide rollers, acting between the rails, being fixed fore and aft of the two main rollers above, thus directing the carriage for running smoothly over the junction of rails to any desired angle without any sign of jamming or jerking.

The chief points of this runway are as follow—Easy pushing of the load along the rails, which, being flat, ensures a smooth motion; shunting over points without extra effort, merely by slightly twisting the load in the direction it is required to go; freedom from jamming into points, or impediment in motion by dropping into openings, as the supporting rollers are made of sufficient width to cover openings, and the conveyance over points is effected without fear of trouble. It will run smoothly round a curve as small as 18 inches. This system is commended to all who would have the best possible means of conveying and manœuvring goods or material rapidly and easily. Our illustration shows the runway.

FIG. 1.—A FLAT-BAR OVERHEAD RUNWAY.

FILLING DEFECTS IN STEEL CASTINGS.*

By Professor Wedding.

It is not difficult and it does not require long experience to avoid entirely defects in ingot iron, whether they appear as gas bubbles, shrinkage cavities, or cracks. However, it often happens that a casting, even after being completely cold, shows a perfect outside surface, but on working it cavities appear which fill the entire cross section, or cracks show which were not visible before. The question will now arise: Can and should one attempt the removal of such defects? I should like to answer the question first of all by the statement that this should never be done without the consent of the purchaser.

There is especially great danger in case of castings on the tensile strength of which demands may be made, because the form and the extent of the defects can seldom be judged from the appearance of the surface. Cavities are often pear-shaped with their small end upward.

If the permission be given for filling the cavities or other defects, there are more or less effective methods for that purpose. Under all circumstances, before proceeding to fill a cavity, its surface must be carefully cleaned of all extraneous matter. Besides, the greatest cross section of the cavity must, if possible, be uncovered. Cracks must be dug out enough to get into them conveniently with the filling material. Before one applies any method whatever, the surface of the space to be filled should be brought to as high a temperature as possible.

Filling by Electric Welding.

The faulty casting may be corrected with one pole of an electric current while the other pole is connected either with an iron or a carbon electrode held near the casting and thus producing an electric arc. In case an electrode is used, this, itself, is melted, and it depends thus on the kind of the steel used how far its properties correspond exactly with those of the casting to be filled. If a carbon electrode is employed, a piece of iron must be melted in the electric arc. In the meantime, the melted metal saturates itself with carbon, and one obtains a filling which possesses less tenacity than the casting which is to be mended.

Filling with Molten Iron.

If a cavity or crack is to be filled by the same material, in a fluid condition, which served for the manufacture of the casting, it is more difficult than in electric welding to bring the piece first of all to a sufficiently high temperature. For this purpose, cast iron is usually employed, which is poured over the defective part until it is brought to a welding temperature. Heavy pressure must be applied, and so over the part to be mended a mould is set, cylindrical in shape and so constructed that it has an entrance and exit channel in order that the fluid iron may flow constantly over the defect. After some time this mould is filled and the iron allowed to solidify.

Filling by Thermit Treatment.

By treatment with thermit, that is, a mixture of iron oxide and aluminum which is burned, one obtains a relatively high temperature, and can easily bring the piece to be treated to such a high temperature that welding is practically assured. To be sure, the iron produced here is a pure iron and consequently possesses less tenacity and greater ductility than the iron mended. Moreover, the thermit treatment has become rather general for such mending purposes.

These three processes just described are used in common welding. They would fulfil their purpose completely if it were possible to determine exactly whether the spaces to be filled had been really brought to the necessary temperature. That this does not happen in a great many cases microscopic investigations prove by revealing a sharp line between the skin of the cavity and that of the added metal so that one must assume that a complete union takes place only in rare instances. It has been frequently attempted, since this phenomenon is attributed to oxidisation, to apply certain fluxes—for example, to fill the cavities first with borax or silica; but this has the great disadvantage that one is not certain of having kept the surface free from slag.

Filling by Patching.

A last method for filling the cavities is as follows:—Iron containing a very small amount of carbon, and as pure as possible, is brought to a welding temperature and then hammered into the cavity after this has likewise been heated. If the cavity in the interior is wider than on the surface, such patching never succeeds. A microscopic examination always shows the joint plainly and proves that this work does not achieve its purpose. In general, one may say that, without special order from the purchaser, this method ought seldom to be pursued, lest it be condemned as a fraud.

* From "The Iron and Steel Magazine."

PATTERNS FOR COLUMNS.

PATTERN-MAKING is of such a varied nature, and its scope so comprehensive, that it is impossible to lay down any hard and fast rules regarding this intricate art.

The building of every new pattern requires to be thought out independently, and this, to a certain extent, accounts for pattern-making being one of the most interesting of trades.

In pattern-making, as in other trades, there are recognised methods of performing certain work, and it is by knowing how and where to apply these methods when occasion arises that the experienced workman is known.

Now, the knowledge of these methods is only gained after many years of experience, and sometimes a pattern-maker finds himself in a difficulty as to how a certain pattern should be made in order that it should comply with the requirements of a first-class pattern, viz., to give the moulder the least possible trouble, and yet be made in such a way that the cost will be kept down to a minimum. In view of this it is our intention to give a few observations on one or two branches of the trade, and select for this article some hints on the preparation of patterns for columns.

To facilitate in moulding, the patterns for columns are made in halves, jointed at the parting line, thus allowing the top half of the pattern to be lifted along with the top part of the mould, and if the column has a moulded cap and base, these should be separate from the main shaft, as it is easier for the moulder to draw each part independently. (See Fig. 1.)

The part which requires most attention from the pattern-maker is the shaft or body of the column, and to this part our remarks will be chiefly confined. When the column is small in diameter the shaft is made solid, but it will be readily seen that when the column is of a large diameter it would be most expensive to make a solid pattern, therefore they are built up in four, six, or more parts, according to the size of the column.

Fig. 2 shows the section of a solid pattern, and when a pattern is got up in this style it is most important that the two faces of the wood which come together at the joint of the pattern shall be the parts which grew nearest the outside of the tree, as shown on Fig. 3, and not as shown on Fig. 4. Owing to its botanical nature, wood, when cut into strips, becomes round on the one side and hollow on the other, as Fig. 5.

The annular rings, which will be seen on the end of the wood, are indicated on the sections.

It will thus be seen that it is most important that this physical property of wood should be observed when bringing two pieces together for a pattern, for in the one case the joints get open, and in the other the joints remain close at the outside edges of the pattern, thus ensuring a better casting and less work to the moulder.

Fig. 6 shows a pattern built in six sections; these sections are made the length of the shaft, and are kept together by hexagonal blocks placed at not more than 3 ft. apart. There should be an odd number of these blocks in the shaft, and every alternate one prepared with a pin in the one half and a socket in the other, thus ensuring pins at each end of the shaft; for example, if the shaft is 15 ft. long there would be five blocks, three with pins, the other two being prepared with rapping plates.

The method for building this class of pattern is as follows: A level board is required a little longer than the shaft, and a straight line drawn at a distance from the edge of the board to allow the edges of the blocks to overlap, the centre of the blocks being kept on a straight line on the board, as shown in Fig. 7. These blocks are temporarily fixed to the board, and the top section is then screwed to the blocks, care being taken that the heads of the screws will not project beyond the finished diameter of the column; the side section is then fitted against the top part, and is in turn screwed to the block, the screws are then withdrawn, and the joint glued and screwed up finally. (See Fig. 8.)

The two sections which now bind all the blocks can now be detached from the board, and the third section fitted and glued up as before.

This completes the building of one half of the drum, as it is called, and after the edges are planed straight the remaining halves of the blocks are put in position and the other sections built up.

Fig. 9 shows a pattern built in four sections; this method is not so popular as the two methods just described, but when adopted the two quarters should be glued up, and when hard the blocks put in position and screwed up.

This completes the description of preparing these different methods of building column shafts prior to being put into the turning lathe.

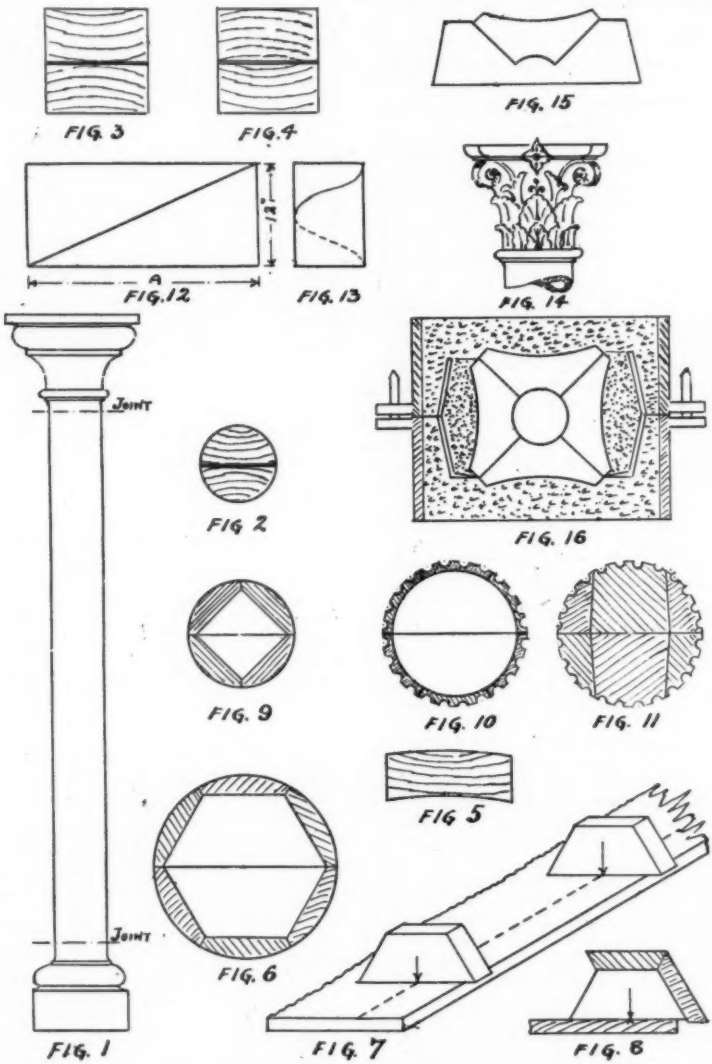
In turning the shaft it should be roughened down to near the required

diameter, and to the finished size for about 2 in. from each end.

The shaft should now be taken out of the lathe and an edge planed straight between the two ends, which are to the finished sizes.

The shaft is again placed into the lathe, and a line drawn along the planed part with a coloured pencil; the column can now be turned down and finished to this line, which can be seen as the shaft revolves without any further sizing. Patterns of columns with ornamental caps and shafts, require special treatment, according to their design.

In columns with fluted shafts, the flutes running parallel with the centre of the column, the shaft is made up of sections



containing the flutes, and the number of sections according to the diameter of the column; blocks are then placed at intervals on the "laying down" board, holding these sections in position, the joints being made at the plain part coming between the flutes, as shown in Fig. 10.

A pattern for one section is made, and the number of sections required are cast from this pattern. These sections, if possible, should be in iron, but sometimes the job cannot stand the expense, or it may not be convenient to have these cast; when this is the case a complete pattern is made in wood; the method adopted is as shown in Fig. 11. Each half of the pattern is in three parts; the two outer portions are secured to the centre part by well tapered dovetails, and made to allow of the centre part being first drawn from the mould, and the side parts drawn in to the remaining space.

In some columns the flutes take a spiral shape on the shaft. The section of spiral flute may vary according to the taste of the designer, but the method of drawing these on the shaft remains the same.

Suppose the spiral is wanted to repeat every 12 in., cut a strip of stout paper 12 in. long, and of sufficient width to go exactly once round the column; when this is done cut the paper through the extreme corners, as shown in Fig. 12, the size A being equal to the circumference of the column. One of the pieces of paper is then wound round the column, and the line drawn along the diagonal edge gives the required spiral, as shown in Fig. 13; this process being repeated up the shaft gives the required line which the flutes are to take.

The casting of ornamental capitals on columns is now an every day occurrence, but until a few years ago the block, or bell, of the cap only was cast on the column, and the ornamental part was cast loose and fitted on.

The design of the capital may vary according to the style of architecture the column is to take, but the style most commonly used for iron columns is Corinthian or variations of this form. (See Fig. 14.)

The pattern is prepared in four sections, each section taking one of the faces; the bottom section is placed on a block, see Fig. 15, and rammed up with the bottom half of the pattern. After turning over the block is removed, and the three remaining sides are put in position; drawbacks are required to take away the side faces.

Fig. 16 shows a section through the moulding-box, with cap and drawbacks in position. The top section of the cap is lifted along with the top part of the mould, and the side sections are drawn along with the drawbacks, and when these are removed the bottom section can then be withdrawn. The thickness of the metal in columns should be regulated by the weight that each column is to carry, but when the thickness of metal is not specified the usual practice is to give an eighth of an inch in thickness to every inch in diameter up to 7 in. in diameter columns 8 in. and above 1 in. thick; for example, a 6 in. diameter column the metal would be $\frac{3}{4}$ in. thick. The diameter of column is the outside of the body or shaft of the column.

It is not possible, in an article such as this, to take up all the points which might be considered in relation to this subject, but the observations given may be taken as showing some of the main principles.

—o—

Sir W. G. Armstrong, Whitworth & Company, Limited, are supplying cast and shear steel to the order of the East Indian Railway Company.

The organisation of the Galvanised Sheet Association is now complete. Mr. H. Somers, of H. Somers & Company, Limited, of Stalybridge and North Wales, has been elected President, and it is reported that 95 per cent. of the galvanised sheet manufacturers has subscribed to the agreement.

The names of the under-mentioned companies have been struck off the Register, and the companies have been dissolved:—Ailsa Craig Machine Company, Limited; Automatic Wagon Coupling Syndicate, Limited; Bromfield Ingersoll Rock Drill Company, Limited; International Engine Patents Development Company, Limited; and the Melingorwg Foundry and Engineering Company, Limited.

The establishment in Sheffield by Mr. Frederick Siemens, of Westminster, London, S.W., of one of his patent furnaces for melting steel in crucibles has created great interest amongst the Sheffield steelmakers, and has led to a similar furnace being built for the use of the students at the Sheffield Technical College under Professor Arnold. Messrs. Leadbeater & Scott, of Sheffield, have also ordered the plans for a 12-pot furnace of the same design, and many other Sheffield steelmakers are sending steel to Mr. Siemens for melting, preparatory to building such furnaces at their own works.

PIG-IRON FOR FOUNDRY WORK.*

By P. Munnoch.

Pig-irons produced in any one district from similar ores are usually similar in character, though from time to time considerable variation occurs in the composition of the iron from any one furnace, and mainly upon this fact depends the necessity of employing a chemist in the foundry, as otherwise, mixtures once found suitable for any particular casting, or class of castings, could always be relied upon to give the same results.

As the pig-irons produced in different districts vary in composition, and, therefore, in character, the founder, by mixing irons from different districts, is enabled to produce compositions suitable to the various requirements of the different castings, upon the production of which he may be engaged. These mixings, which are the result of careful trial and observation, are usually suitable for the purpose for which they are required, though sometimes the reverse is the case; but the variations occurring in the compositions of the different irons used often produce quite a different result from that desired.

There is no sharp line of demarcation between the grades of iron produced at the blast furnace, one grade gradually merging into another; therefore it will be seen that the iron delivered will depend, to a certain extent, upon the ideas of the sampler, and no doubt the amount and grade of the iron made at the furnace, as compared with the orders on hand, to some extent influence his judgment.

Table I. gives typical analyses of pig-irons from different districts. These are chiefly from the author's own analysis, one or two having been added to make the list complete. No. 3 iron is taken in each case for sake of comparison.

Variations in the Composition of Pig-Iron.

In ordinary foundry pig-irons the variations in the amounts of total carbon, phosphorus, manganese, and sulphur are generally small compared with the variations of silicon. This element varies to a very great extent from time to time, and a variation of 2 per cent. or even more may be met with in the same delivery of iron.

Where irons are made from mixtures of ores, there is usually more variation in the manganese and phosphorus than is the case where irons are made from one class of ore.

As a general rule, in any one brand of iron, as silicon increases, sulphur decreases, and as silicon goes down sulphur goes up. This rule, however, cannot be applied haphazard to any collection of pig-iron samples, as a high silicon is frequently associated with a high sulphur, and a low silicon with a low sulphur.

Table II. contains an example of ideal analyses and grading of Cleveland iron. Also several examples of extreme variations actually found in the irons used at the works of Richardsons, Westgarth & Company, Limited, Middlesbrough, and are inserted by kind permission of Mr. T. Westgarth, managing director.

	Grade	Combined Carbon	Graphitic Carbon	Manganese	Silicon	Sulphur	Phosphorus
Cumberland Hematite	No. 3	·17	3·51	1·1	2·49	·040	·035
East Coast Hematite	No. 3	·47	3·32	·97	2·63	·057	·050
Cleveland	No. 3	·17	3·00	·30	2·75	·050	1·54
West Yorkshire	No. 3	·25	3·10	·95	3·00	·063	·97
Lincolnshire	No. 3	·75	2·76	1·00	2·14	·036	1·27
Derbyshire	No. 3	·05	2·97	·90	2·47	·035	1·50
Northamptonshire	No. 3	·08	3·04	·29	2·75	·029	1·09
Nottinghamshire	No. 3	·15	3·20	·40	2·70	·049	1·10
Lancashire	No. 3	·10	3·23	·71	3·03	·051	·97
North Staffordshire	No. 3	·67	2·90	2·05	2·50	·035	1·25
Ayrshire	No. 3	·47	3·01	·99	2·33	·027	·56
"	No. 3	·42	2·87	1·49	2·61	·032	1·15
Lanarkshire	No. 3	·19	3·10	1·20	2·15	·014	·81
Stirlingshire	Close No. 3	·68	2·72	1·08	1·88	·101	·61
South Staffordshire	Cold Blast	·55	2·50	·53	1·06	·101	·48
North Yorkshire	Cold Blast	·61	2·62	·48	·98	·048	·40

Table I.—Typical Analyses of Pig-irons.

Influence of Composition on Grade and Fracture of Pig-Iron.

No. 1 iron is usually higher in total carbon and manganese than the lower grades, and also lower in sulphur. Silicon is generally, but not always, high. As the grade goes down sulphur and combined carbon increase, whilst silicon and manganese generally decrease. Irons rich in total carbon have a much darker and more open grain than irons otherwise similar in analysis, which contain a lower total carbon. This is due to the higher content of graphite. Irons with a low total carbon usually have close grain and a light coloured fracture.

Sulphur, to a large extent, controls the grade as determined by fracture, and also controls the combined carbon. Com-

* From a paper read before the Cleveland Institution of Engineers.

bined carbon usually increases with increase of sulphur. Irons low in sulphur usually have a large open grain; as it increases the grain becomes closer.

With a high total carbon sulphur may be increased slightly above the normal without affecting the grain; in this case there is usually an increase in combined carbon. Silicon in ordinary normal foundry irons appears to have only a slight effect on fracture and grade. When silicon increases it usually displaces total carbon, thereby lowering the combined carbon. Iron with above 4 per cent. of

CLEVELAND IRON.—IDEAL ANALYSIS.

Grade	Combined Carbon	Graphitic Carbon	Manganese	Silicon	Sulphur	Phosphorus
No. 1	10	3·90	·45	3·30	·02	1·60
No. 2	15	3·20	·45	3·20	·03	1·57
No. 3	·30	3·00	·60	2·75	·05	1·57
No. 4 Foundry	·40	2·85	·55	2·25	·08	1·55
No. 4 Forge	·70	2·50	·50	1·75	·13	1·57
Mottled	1·00	1·77	·30	1·00	·25	1·58
White	3·05	nil.	·20	·75	·45	1·60

CLEVELAND IRONS.—ACTUAL ANALYSES.

No. 1	·15	3·15	·60	2·80	·035	1·59
No. 3	nil.	3·10	·55	3·65	·040	1·39
No. 3	·80	2·60	·57	1·40	·054	1·54
No. 4 Foundry	trace	2·95	·61	3·53	·033	1·51
Name	·56	2·69	·40	2·10	·051	1·60
Delivery	·97	2·47	·39	1·21	·075	1·66
Name	from			2·24		
Delivery	to			3·06		
No. 4 Forge	·50	2·55	·10	2·45	·035	1·61
No. 4 Forge	1·12	2·17	·27	·90	·141	1·66
Mottled	1·46	1·76	·02	1·75	·280	1·59
"	·90	2·30	·31	·93	·227	1·63

HEMATITE IRONS.

No. 1			1·33	3·25	·027	·06
"			·93	2·39	·027	·06
"	·06	3·77	·72	1·04	·027	·06
No. 2				1·75	·038	·06
"	·92	3·14	1·38	1·33	·043	·06
No. 3	·58	3·18	·73	1·40	·060	·05
"	·45	3·33	·90	3·10	·030	·08
No. 4 Forge	·40	3·02	1·12	2·91	·095	·042
"	·73	3·13	·48	·69	·116	·055

TABLE II.—VARIATIONS IN ANALYSES OF PIG-IRONS.

silicon usually shows a silvery appearance, and is called glazed iron. With a low silicon a relatively higher total carbon is necessary to give an iron of similar appearance to one which contains a higher or normal silicon.

Iron low in silicon is very sensitive to the action of chilling, and this is greatly influenced by both sulphur and manganese. Manganese in ordinary foundry iron does not appear to have much effect upon appearance of fracture when below about 3 per cent., although the presence of much manganese renders the iron hard to drill or machine. Practically the effect of manganese is to increase the combined carbon without affecting the grade as determined by fracture. Combined carbon does not appear to have a great effect on the appearance of pig-iron except when the iron begins to show a forge or mottled fracture.

Phosphorus has practically no effect upon the grade of pig-iron as determined by appearance of fracture. As phosphorus increases total carbon decreases, and the normal amount of total carbon varies from about 3.75 per cent. in normal hematites down to about 3.30 in normal Cleveland irons containing 1.5 per cent. of phosphorus, that is to say, with an increase of 1.5 per cent. of phosphorus there is a decrease of 0.45 per cent. of total carbon.

Phosphorus has no effect upon combined carbon, but as phosphorus increases the iron shows a lighter colour due to the phosphide of iron present.

The appearance and grade of pig-iron is affected to a great extent by the varying conditions of casting and cooling. This makes it a difficult matter to determine the effect of composition on fracture with any degree of certainty.

Mixing by Analysis.

The object of this is to turn out castings of uniform analysis. As the physical or mechanical properties of cast iron depends on its chemical composition, together with the effects of the conditions of melting, casting, and cooling, it may be taken, as a general rule, that metal of similar analysis, melted, cast and cooled under similar conditions, will produce resulting castings having similar physical or mechanical properties. This leads to the foundation of mixing by analysis, that, if the resulting metal is of the same analysis and the other conditions are the same, the castings produced will have the same properties, independent altogether of the brand or brands of iron used.

This, in turn, brings forward the fact that the properties of such special irons as cold blast depend upon the composition; cold blast is only the means of producing this composition, and if an iron having the same composition could be produced by means of hot blast, the iron would have the same properties. Furnaces working with hot blast usually produce an iron having a higher total carbon when making iron which is otherwise similar in analysis.

It is possible to reduce the total carbon by the addition of steel, and thus duplicate cold blast irons. Selecting and mixing irons by analysis renders the founder independent of any particular brand or brands of iron, and enables him to substitute low-priced for high-priced ones.

The low-priced irons may in some cases be more suitable than the higher-priced irons.

The founder who is so placed that he has irons from different districts at his disposal is enabled to change his irons as the markets change, and at the same time produce castings of suitable composition and mechanical properties.

The ideal method of working is to buy irons by analysis; at the present time this is a difficult matter, as few makers of pig-iron are willing to sell by analysis. Those who are willing to do so require a higher price for selecting the iron.

At the present time, therefore, irons must be bought by grade, and, as they vary from time to time, a certain amount of stock must be kept for mixing. This is not so much a question of large stocks as a judicious selection of irons which can be used to correct any irregularities which may occur from time to time in those bought, and which may also be used for producing mixings for castings requiring special or unusual composition.

Usual Composition of Castings.

It is by no means necessary, when in any particular district, to turn out castings of the same analysis as would be done in another district, where the irons within reach of the founder may be different in composition. In those districts where high phosphorus irons are cheapest, phosphorus will be found to be higher in the general output of castings than is the case where irons of a lower content of phosphorus are cheaper; the same also applies to manganese.

Castings for machinery and general engineering work vary greatly in composition in different districts, but, as a general rule, the phosphorus averages about 1 per cent.; this may be due to the fact that the general average of all the pig-irons produced in this country is about 1 per cent. phosphorus.

Manganese usually varies from .3 to 1.5 per cent., but the average is about .7 per cent.

Silicon may vary from 1.0 to 3.0 per cent. The average is about 1.8 per cent. Total carbon usually 3.2 to 3.5 per cent.

Combined carbon varies to a very great extent. In some cases the total carbon is entirely in the form of graphite, in others the greater part may be combined. Combined carbon may vary to a great extent even in the same casting.

Sulphur usually varies between .03 per cent. and .15 per cent.

In special engineering castings, where great strength is required, total carbon, manganese, silicon, and phosphorus are usually all low.

For castings requiring to be extremely soft and tough, hematite iron alone is used.

Iron for special castings is, in some cases, remelted once or twice before casting. This is only necessary when a higher grade of iron than is required is being used. Where reasonable care is taken in the weighing of all materials charged into the furnace, the results will be quite as regular without this remelting.

The effect of remelting in the cupola is equivalent to lowering the grade.

Usually silicon is decreased by .2 to .3 per cent.

Sulphur usually increases to the extent of .02 to .04 per cent.

About 25 per cent. of the manganese is lost.

Total carbon increases or decreases according to the amount present, whether below or above the normal.

With regard to mixing by analysis applied to the foundry, this cannot be a success unless the necessary requirements are observed. These are, briefly, a reasonable amount of stock of the different brands and grades of iron necessary and a small stock of extremes for correcting variations.

Sufficient yard room for stocking purposes. This should preferably be near the cupola to save unnecessary handling.

Suitable means for weighing all materials charged into the furnace.

Unless these requirements are complied with it will be impossible to mix by analysis.

The question as to whether or not an analyst is of benefit to the foundry is a delicate one to attempt answering, and can only be answered by those who employ one.

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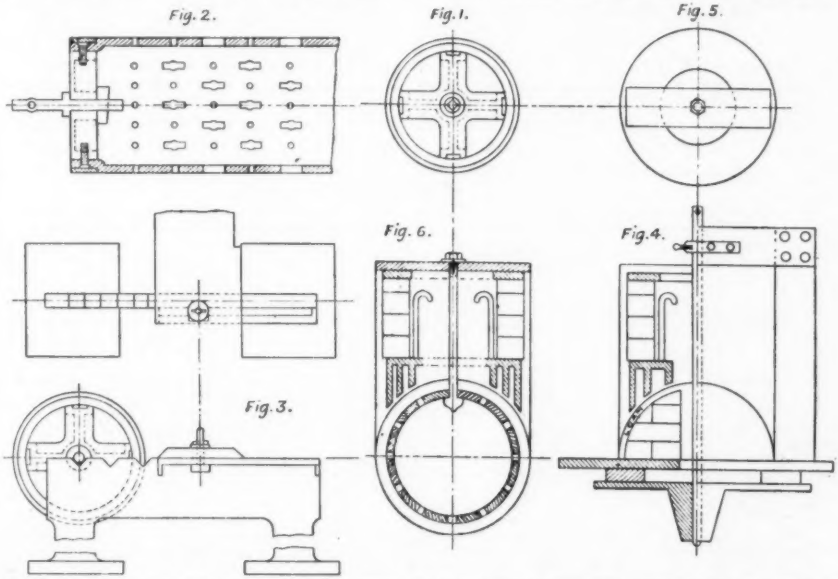
An application for the discharge from bankruptcy of Mr. E. Smedley, iron-founder, of Driffield, formerly a partner in the Park Foundry Company, has been suspended for three years.

The Brush Electrical Engineering Company, Limited, expended the sum of £11,507 on additions to plant and buildings at their works during last year. The company's Universal engines have not proved satisfactory in some sizes, and their manufacture has been entirely discontinued. Marked progress was made during the year at the Falcon Works in developing new manufactures and in improving existing designs.

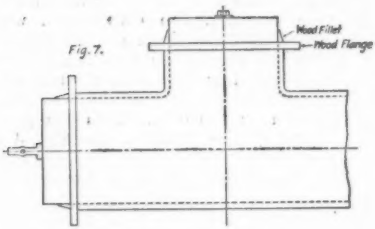
HOW TO MAKE A SOCKETED FLANGED OR SPIGOTED BRANCH PIPE WITHOUT CORE IRONS AND PLATES.

In the first place, we take a core bar from the stock bars of various sizes, which are always kept in readiness to meet requirements. These bars, in the smaller sizes, are made of wrought iron. The larger are made of cast iron. The wrought iron sizes are from 8 in. to 12 in. and the cast iron sizes from 12 in. to 48 in. diameter. In Fig. 1 is given an end elevation of the bar with the cross inserted into it, and in Fig. 2 is shown a sectional view of the bar showing the means of fastening the cross in the end of bar and the mode of fastening the spindle, which may either be riveted in or cottered. The reason why it is shown as being cottered is that the spindle may be taken out when a close-ended syphon (branched or plain) is being made. In that case a cast iron plate is fastened to the cross to close the end. In Fig. 2 is also shown the key holes whereby the branches are fixed to the bar. These holes are slotted in shape and are cast into the bar at different distances to suit requirements. These bars are tapered from ½ in. to ¾ in., according to size, in order that they may be easily withdrawn. They also have wrought iron hoops shrunk on to the recessed ends to preserve them from breaking. In Fig. 3 is shown an end elevation of the range with the core bar and the core board, with cottered attachment in a slotted groove, by which the size of the core is adjusted. The core board is also shown as having a plain side, and a recessed side to form the pattern on the core. This also gives the length of the pattern. In Fig. 4 is shown an half elevation and sectional view of the means used to form the branch core. The bed plate rests upon a three-armed jig, into which the spindle is inserted, with the sweep attached by the gland to the spindle, and it revolves around a loam block which is a counterpart of the core for size, which has been previously prepared for the building of the branch upon it. In Figs. 5 and 6 is seen the means employed to fasten the built up branch upon the core. A sectional view is also shown in Fig. 6. By means of a key screw, which is inserted through the slotted hole in the bar and turned a half way round to fasten it, a cross bar is then placed over the end of the branch and then screwed down tight. It will hold



MAKING A SOCKETED FLANGED OR SPIGOTED BRANCH PIPE WITHOUT CORE IRONS AND PLATES.

fast in any position. In Fig. 7 is shown a sectional view of the pattern with the flanges. They are fastened up to the loam shoulder of thickness by means of



taper wood fillets nailed into the core. If there are many to make off the same pattern it is coated with tar and placed in the stove, minus the flanges, to harden it. It then presents a smooth surface

THE NEW WHEEL FOUNDRY OF THE PENNSYLVANIA RAILWAY.

For a number of years the Pennsylvania Railway has been making part of the cast-iron wheels which it requires at two foundries which form a part of the Altoona shops. Each had a capacity of about 220 wheels a day when running full time, but this was not sufficient to meet the requirements, and a new foundry was decided upon.

There are six main buildings, an office building 40 ft. by 60 ft., the wheel foundry 188 ft. by 602 ft., the iron foundry 162 ft. 8 in. by 563 ft., with a bay for core room and washrooms 60 ft. by 344 ft., the pattern shop and pattern storage 91 ft. by 286 ft. (part of which is three stories high), power house 89 ft. 1 in. by 160 ft. 8½ in., and material storehouse 60 ft. by 110 ft. 3 in. All of the shop buildings are

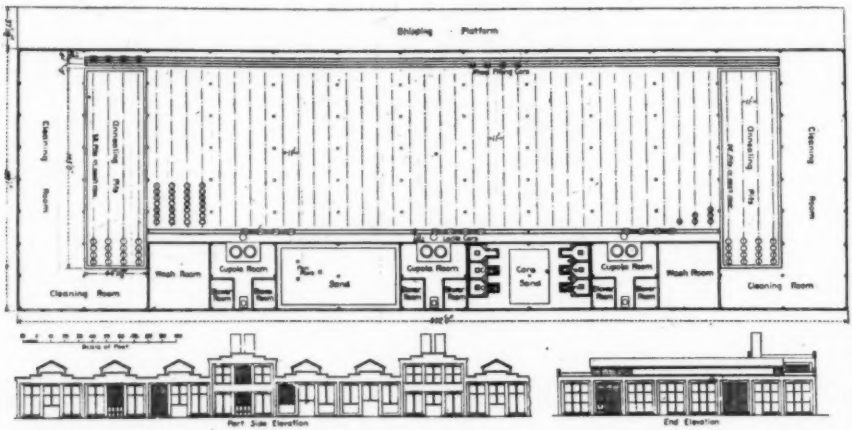


FIG. 1.—GENERAL PLAN OF WHEEL FOUNDRY.

which will stand wear and tear for some time. In large foundries the smaller moulds are made in green sand, and the larger moulds in dry sand, rammed up in cast-iron boxes made to suit. The views shown represent a 24 in. on 24 in. flanged pipe pattern.

MESSRS. ELDER DEMPSTER have recently established a concern to be known as the Forcados Engineering Company. In connection with this, the Elder Dempster Company have placed an order with Swan, Hunter & Wigham Richardson, Limited, for a large pontoon dry dock to be stationed at Forcados, West Africa.

of brick with steel roof construction. Standard tracks are laid through the grounds from one end to the other. A system of narrow tracks is also laid in and around the two foundry buildings for carrying material through the shop and from the storage house.

The wheel foundry is the largest and most important building of the group. It is laid out with straight parallel moulding beds holding 25 moulds each, with overhead trolley hoists running on I-beam tracks suspended from the roof trusses and serving each row of moulds. This is a distinct advance over the old method of moulding on circular beds served by a

post crane, both in ease and rapidity of moulding and pouring and in saving of floor space. The arrangement of cupolas and moulding floors is virtually that of three separate foundries placed alongside of each other under one roof, each pair of cupolas serving three bays of four moulding floors. An annealing pit and cleaning floor occupy each end of the building, and the space along the east side of the foundry is utilised for the core room, sand storage, cupola rooms, and wash room. The entire west side of the building and the end walls are almost all glass.

The six cupolas are 58 in. in diameter inside of lining, and have a capacity of 12 tons an hour. They are arranged in pairs just back of the partition wall between the moulding floor and the cupola room. The tap holes are about 8 ft. above the floor, and the two spouts project through the wide opening in the wall, coming together at their outer ends over the receiving ladle. Blast for the cupolas is supplied by four Sirocco fans and two Sturtevant fans delivering air at a pressure of about 14 in. of water. Each fan is mounted in an enclosed space at the back of the cupola room on the first floor, and is driven by a belt from a 60 h.p. motor.

The cupola room is carried up to two stories, and the charging platform is on the second floor. A hydraulic elevator raises the small cars which are loaded with the charge of coke and iron outside the building. Tracks run from the elevator across the charging floor to the door of each cupola, and the charge is put by hand through the charging doors.

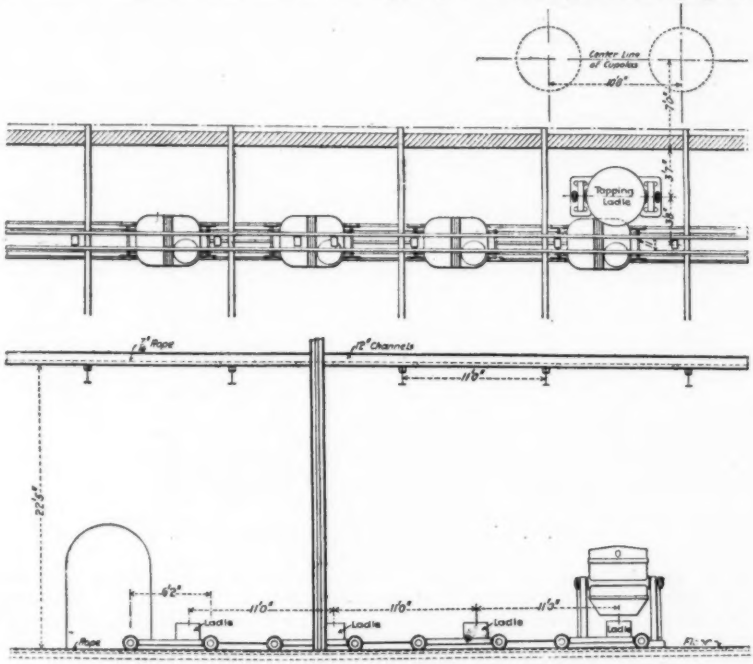


FIG. 2.—LADLE ARRANGEMENT IN FRONT OF CUPOLAS.

Under the tapping spouts of each pair of cupolas is a receiving ladle mounted on trunnions and tilted by a chain wheel. The chains for tilting are connected to two hydraulic cylinders under the floor, which are controlled by a valve conveniently placed against the wall. These ladles have a capacity of seven tons. Running along in front of the ladles is a narrow track for the ladle cars. The arrangement of these cars is shown in one of the drawings. They consist of a shallow box mounted on four small wheels and four of them are coupled up together, the couplings being of the proper length

to space the cars 11 ft. apart, centre to centre, the same distance as between the moulding floor trolley runways. An endless rope drive running between the rails and up to the motor-driven winding drum mounted on the roof trusses is for moving them. The controller for the winding drum is placed near the valve controlling the tilting of the reservoir ladle so that one man can operate both. The travel of each train of cars is limited by the arrangement of the winding drums and ropes to the three bays of the moulding floor served by one pair of cupolas.

The hoists serving each row of moulds were supplied by several different makers, but all are essentially the same, having two hoisting speeds and two traverse speeds with one controlling lever for both movements. The maximum hoisting speed is 30 ft. per minute at full load and 75 ft. per minute at light load, and the maximum traversing speed is 350 ft. per minute at full load, and 400 ft. per minute at light load. Each hoist has two 2½ h.p. enclosed motors, and the capacity is 3,000 lbs. Current is collected by contact wheels running on wires strung outside of the top flange of the I-beam track. The controller is an ingenious but simple device An outrigger arm is attached to the hoist frame and carries a hollow horizontal shaft with a second shaft inside, one being connected to the controller of the traverse motor and the other to that of the hoisting motor. At the outer end of the hollow shaft is a bevel gear meshing in a gear on top of the vertical rod of the controller handle. The inside shaft carries a horizontal rod with wires at the ends leading down to the cross bar of the controller handle. By turning the controller handle in a horizontal plane the hollow shaft is revolved, and the trolley motor started. By tilting the cross-bar in a vertical plane the inside shaft is revolved and the hoist motor started. The motors are reversed by tilting or turning the handle in the opposite direction. By dropping the controller from an outrigger the operator stands away from the moulds when handling the hoist.

The moulding floor is 112 ft. by 414 ft., and will accommodate 900 moulds, which is a day's full run. Along the west wall of the building are two narrow tracks running the entire length of the foundry on which the wheel pitting cars are run with a cable haulage system similar to that on the tracks in front of the cupolas. The wheel pitting cars differ but slightly from the ladle cars, the body being simply a circular ring of steel plate 21½ in. in diameter and laid on edge. The wheels rest on this ring without other fastening. The cars are coupled up in fours, and are spaced 11 ft. centre to centre, so as to come exactly in line with each of the four moulding beds in each bay.

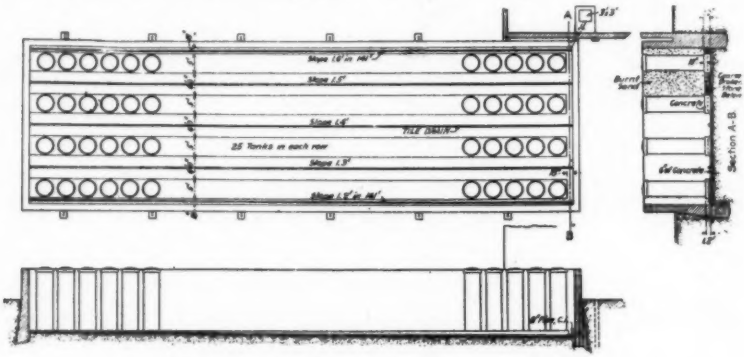


FIG. 3.—ARRANGEMENT OF ANNEALING PITS.

The operation of the foundry is systematic and rapid. A moulder and two helpers are assigned to each row of 25 moulds, and are supplied with that number of flasks and chills. They begin moulding in the early morning at the west or far end of the row, and proceed toward the cupolas, the cast numbers of the wheels beginning with the first mould. By 11 o'clock the day's moulding is completed and pouring off begins. The blast is turned on about 10 o'clock, and hot iron, which is essential for this class of work, is obtained at the beginning of the run. The cupolas are tapped out into the storage reservoir, from which the iron is poured into the pouring ladles on the

cars. As each ladle is filled the train of cars is run forward 11 ft. and the next ladle filled. When all four are full the train is run out opposite the four rows of moulds in a bay, and the trolley hoists pick the ladles up, carrying them to the outer end of the row. One helper manipulates the hoist, the moulder pours, and the other helper skims. All four moulds are poured simultaneously, and the empty ladles are then run back to the cars, which have meanwhile carried four more ladles to one of the other bays and returned for the empty ones. In this way the pouring goes on continuously until the day's run is finished. After about three wheels have been poured, the cope is lifted and the wheel drawn from the sand.

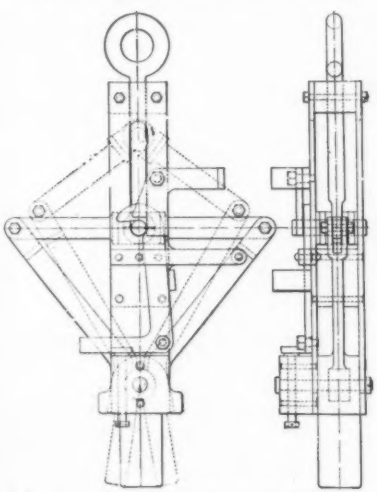


FIG. 4.—WHEEL PITTING TONGS.

While it is suspended the runners are broken off with sledges and the rim is struck with several sharp blows of a sledge to knock off most of the clinging sand. It is then run out to the end of the row and deposited on one of the train of wheel pitting cars to be carried to the annealing pits. As fast as the moulds are broken up, the flasks and chills are set up ready for the next day, and the sand is cut, watered, and banked.

The annealing pits at the ends of the foundry are duplicates of each other. They are 45 ft. by 145 ft., and are 16 ft. deep. The arrangement of the tanks and filling is shown in one of the drawings. The rubble masonry walls extend 8 ft. above the floor line, and about 14 ft. below. The bottom of the pit is laid with 6 in. of concrete, and slopes towards one corner for drainage. Each of the four rows of tanks rests on a concrete bench, and about 18 in. of coarse broken stone is laid over the floor up to the tops of these benches. On top of this is a layer of finer stone, and then green and burnt sand up to the top of the walls. The tanks are $\frac{3}{8}$-in. steel, lined with 6 in. of fire-brick, and have an inside diameter of about 40 in. The rows are 11 ft. apart, centre to centre, and the tanks in each row are separated about 18 in. The tank covers are cast iron with a lifting ring. Each tank will hold 23 wheels, or a total of 2,300 wheels for each pit. The daily cast, when running full, is 900 wheels, so that the pits have a sufficient capacity to give five days' annealing.

The pit is spanned by a crane carrying four independent hoists, spaced 11 ft. apart on the bridge, to cover each row of tanks. The runway extends out beyond the west end of the pit over the wheel pitting tracks, and is supported on brackets on the roof columns. A spare hoist is mounted on the bridge, and in case of a breakdown it can be moved to the proper position and secured to take the place of the broken hoist, which can be moved out of the way. The hoist motors are $7\frac{1}{2}$ h.p., and are controlled from separate controllers in the cab which hangs from the bridge at one side. The crane is moved over the pits by a 10 h.p. motor, and to provide for emergencies a spare motor, which can be quickly coupled up, is installed. In addition to these precautions against a breakdown, which would practically shut down the foundry, a spare controller is provided which can be connected through the switchboard to any one of the hoisting or traverse motors. The speed of the hoists is 100 ft. per minute with full load and 200 ft. per minute without load, and the speed of the bridge is 500 and 550 ft. per minute. The wheels, after being roughly cleaned and placed on the pitting cars, are run to the end of the foundry opposite the annealing pits, and all four wheels are picked up simultaneously with special tongs, carried over the pit to a row of tanks already opened, and dropped. These special tongs are an ingenious device and are shown in one of the engravings. The full lines show the position of the parts before lifting, and the dotted lines show the position when lifting the wheel. The two bent links are hinged at the bottom of the vertical frame, and their projecting ends, when brought together, just fit into

the rough hub of a wheel. At their upper ends they are joined to a pair of toggie links attached to the bottom of the lifting eye by a projecting pin, which works in a slot in the frame. When the lifting eye is raised the projecting ends of the bent links are forced out and grip the sides of the wheel hub. Before the tongs are lowered into a wheel the right-angled arm, which has a hook at its upper end, is hooked over the projecting pin at the bottom of the lifting eye so that the weight of the tongs will not spread the gripping fingers. As the fingers drop into the wheel hub the pin shown at the bottom of the frame is forced up by the rim of the hub and forces the locking arm out of a vertical position, thus releasing the projecting pin and allowing the lifting eye to move up when a lifting force is applied Before the wheel is lifted off the pitting cars the trigger shown at the top is thrown over so that one arm bears against the projecting pin. Then, when the wheel is deposited in the pit or on the floor, and the lifting strain on the eye is released, the pin moves downward in the slot in the frame. This throws the trigger over so that the notch engages on top of the pin. As the tongs are withdrawn the pin holding up the other locking arm drops and allows the hook at the top to engage with the pin. The trigger is then released and the tongs are ready to pick up another wheel.

After five days in the annealing pits the wheels are taken out by the crane and deposited on the floor of the cleaning room at the east end of the pit. Here they are chipped, brushed, and inspected and rolled out on to the shipping platform, which is 38 ft. wide and extends the whole length of the building. The track for loading cars is depressed, so that the car floors are on a level with the shipping platform, and the wheels can be rolled on board without lifting.

The core room is located about the centre of the east side of the building between the two cupola rooms, and is 46 ft. by 88 ft. Two sets of core ovens are provided. The drawings show their construction quite clearly. Each oven contains seven circular shelves mounted on ball-bearings on a central shaft, and turning independently of the others. Each shelf will hold 41 ring cores or 287 cores per oven. The grate is below the floor line, and the coke is fired from a pit in front of the doors. The room corresponding to the core room on the other side of the middle pair of cupolas is used for moulding sand storage, both the core sand and moulding sand being shovelled through doors directly from the cars standing on a track running close alongside the building.

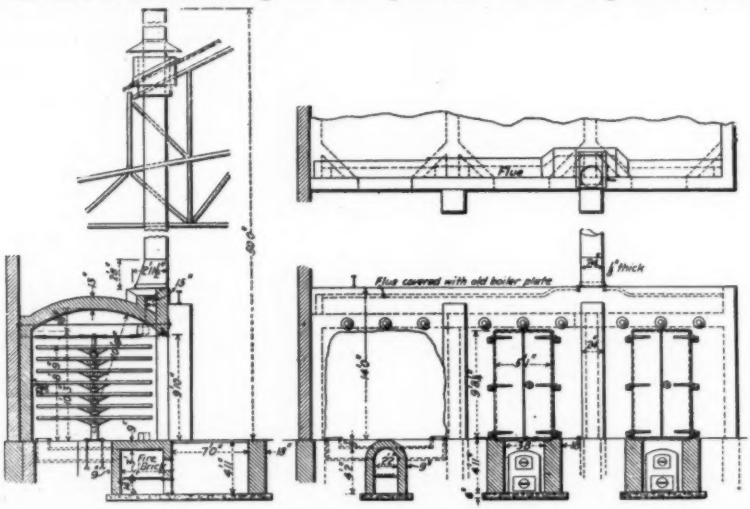


FIG. 5.—ARRANGEMENT OF CORE OVENS.

The wash rooms and locker rooms are located at the two ends of the building. Every provision has been made for the

men in the way of separate expanded metal lockers for each workman, enamelled wash basins and shower baths, water-closets and urinals. The shower baths, closets, and urinals are partitioned off from the rest of the room so that no odours escape. The rooms are well lighted and heated, and are clean and comfortable.

The coke and iron storage yard is along the east side of the foundry between it and the grey-iron foundry. The coke wharf is 24 ft. by 108 ft., with nine pockets on each side. Room has been left for extension 108 ft. long to be built when needed. A narrow track runs along under the pockets for loading the charging cars, and turnouts from this track lead through each of the three scale houses located opposite the cupolas. Scrap and pig is piled in the space to the west of this industrial track, and can be loaded on the charging cars from either side of the pile. The scale houses are frame buildings bays. Part of the west side bay will be taken up with three cupola rooms. The rooms near the ends of the foundry will contain two 96-in. cupolas, having a capacity of 18 tons an hour each, and the middle room will contain a single Mackenzie cupola of smaller size for melting hard iron for cylinder castings and similar work. Each cupola will have its separate blast outfit, and the arrangement on the charging floors will be similar to that already described for the wheel foundry.

The core ovens will be in the east bay, and the core room will be immediately behind them in a lean-to addition, containing also a sand mixing room and wash room. Sand storage pits will be under the core room, and a conveyor system will be installed for filling them from the dumping pits under the unloading track outside the building.

The central bay of the foundry will be spanned by a 25-ton travelling crane and

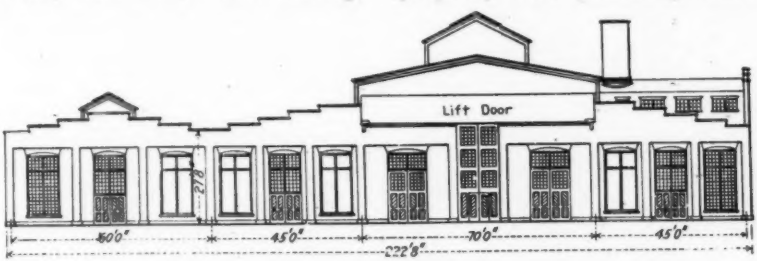


FIG. 6.—END ELEVATION OF IRON FOUNDRY.

covering the track scales, and the charge is all weighed in the cars before being delivered to the charging floor. A wheel breaker is provided for each pair of cupolas located alongside the scale house. It consists of a cupped anvil and a heavy drop weight raised by a hydraulic hoist.

A complete system of heating and ventilating the foundry building was installed by the Sturtevant Company. One disadvantage, however, is that the warm dry air dries out the moulding sand quickly and makes it difficult to keep the sand moist and in good condition.

The iron foundry, when completed, will be used chiefly for making castings for car and locomotive repairs and new locomotive engines. It will be as complete in its equipment as the wheel foundry and as modern in every respect. The building, which is 564 ft. long by 162 ft. 8 in. wide, is divided into three longitudinal two other 5-ton cranes for lighter work. Travelling cranes will also be installed in the side bays, and movable post cranes to be attached to the roof columns will be supplied. Outside of the building at each end is a flask storage yard and loading tracks, and these yards will have crane runways 280 ft. long continuing out from the crane runway of the middle bay of the foundry. The ends of the building are arranged to open to permit the 25-ton crane to run in or out, carrying flasks or heavy castings to be loaded on cars. The door operating device, which has also been used in the Altoona and Juniata shops, is shown in one of the drawings. The brick end wall, which extends up to the level of the crane runway, is cut out for a double door 12 ft. wide and 29 ft. high. Above the runway the opening is closed by a lifting door extending the entire width of the middle bay and high enough to give the necessary clear-

ance for the crane bridge. This door is made as light as possible of sheet iron and angle iron framing, and is arranged to swing up inwardly. The operating mechanism consists of a horizontal transverse shaft revolved by a bevel box gear in the centre, turned by a motor on the end of a longitudinal shaft. At eight points on the transverse shaft are pinions meshing with segmental racks on the upper end of the vertical frames. The door is hung on a shaft passing through the centres of the segmental racks, and as the transverse shaft is turned the door is swung up inwardly. This has been found to be a simple and satisfactory door in every way.

The lighting of the iron foundry is as excellent as that in the wheel foundry,

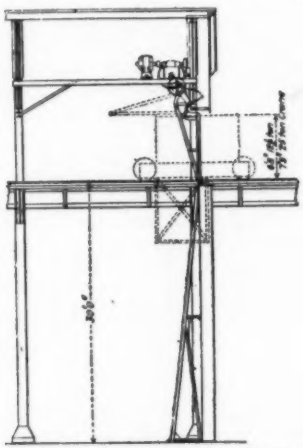


FIG. 7.—ARRANGEMENT FOR OPERATING DOORS—IRON FOUNDRY.

as is evidenced by the amount of glass shown in the elevation drawings. The ventilation system will be very similar to that in the adjoining building, with the exception that the main ducts from the ventilating fans will be laid in the foundations under the floor with openings up through the walls. There will be three sets of fans and heaters.

The cleaning floor is at the north end of the foundry in the middle bay. The castings will be cleaned on iron gratings over a pit under the floor, and the burnt sand dropping into the pit will be loaded on to small cars and carried out through a tunnel which emerges just beyond the end of the building. The narrow track in the tunnel continues on to a loading platform at the north end of the company's grounds, where the burnt sand will be loaded on to cars.

The pattern shop and pattern storage house are south of the iron foundry and well away from the other buildings. The pattern shop is one storey high, 91 ft. by 193 ft., and the storehouse is the same width, but 180 ft. long and three stories high. The two are separated by a 12 ft. hallway on the lower floor, and in this hallway are the elevator and stairways, which are the only means of reaching the store rooms above. Each floor is divided into three rooms connected by fireproof doors, which are always kept closed. Automatic sprinklers are to be put in the rooms, and to prevent overweighting the floor in case a room is flooded, weep holes are cut in the side walls on each floor. The system of storing patterns and keeping records has no features of special interest.

At the present time the wheel foundry is running at half its capacity, or 450 wheels a day. All weights of 33-in. wheels for freight service are being made, and also a number of 36-in. wheels for passenger service. About 60 moulders and helpers are at work. The iron foundry and pattern shop will be in use by the summer.—"Railroad Gazette, New York."

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THE HORSLEY COMPANY, LIMITED, are supplying the Burma Railways with steel water tanks.

THE MELBOURNE GALVANISING WORKS, Wolverhampton, of Pinson & Evans, Limited, were recently purchased by Mr. J. Pinson and another director of Messrs. Pinson & Evans, Limited, for £6,000.

MESSRS. KITSON & COMPANY, of the Airedale Foundry, Leeds, are supplying five powerful express locomotives of the well-known "Atlantic" type for the London, Brighton, & South Coast Railway Company.

THE new electrical installation at the Wolsingham Steel Works, Durham, is now in operation. The transformation from steam to electricity has been under way for a considerable period, the main contractors being Messrs. Bruce, Peebles & Company, of Edinburgh.

SHIPBUILDING was once a thriving industry on the Mersey, but during recent years it has almost entirely died out. The Estates Committee of the City Council has now decided to prepare a report on the practicability of providing shipbuilding accommodation on the Mersey.

SHEDDEN'S MOULD DRYER.

THE annexed illustrations show a mould dryer made by Thomas Shedden & Co., of Paisley, N.B., which is in use by Wm. Beardmore & Company, James Howden & Company, Vickers, Sons & Maxim, and other large firms. The furnace consists of a rectangular box or chest built with steel plates, and held together with angle iron. The angle iron is produced at each corner to form legs or supports so that it can be laid down anywhere. The furnace is lined inside with firebricks built in with fireclay. At the front end of the box there is a heavy perforated plate for the furnace. This plate is supported at each corner, and raised up so as to admit the blast up through the furnace. At the inner end of the furnace plate there is an interior wall raised up 2 in. from the top, which divides the furnace from the back combustion chamber. At the front end of the box or chest, and just outside the furnace, there is a valve casing which consists of three valves; an outer or admission valve and two interior valves. The one at the bottom is for admitting the air up through the furnace, and the one at the top is for letting the air in over the furnace and forcing the heat down into the moulds as rapidly as possible. The outer or admission valve can be adjusted for a large or small blast in proportion to the size of the mould that is to be dried.

On the side of the box there is a small lifting door for drawing the ashes out from under the furnace. On the other side there is a draw door for cleaning out the furnace. Near the back end of the box or chest there are two sight holes into the back combustion chamber for watching the progress of the heat down into the moulds. At the bottom of the back combustion chamber there is the discharge pipe, which is so arranged that it can be set down on the top of the pipe which conducts the air down into the moulds. The lid or cover plate is made bilged on the top side so as to reduce the chance of cracking. It is fitted with dabbers on the underside for a thick coating of fireclay. On the front half, and right over the fire, there is a small lid or door for supplying fuel to the fire, and on each side, and near the centre, are the lifters for carrying the furnace to wherever it is required.

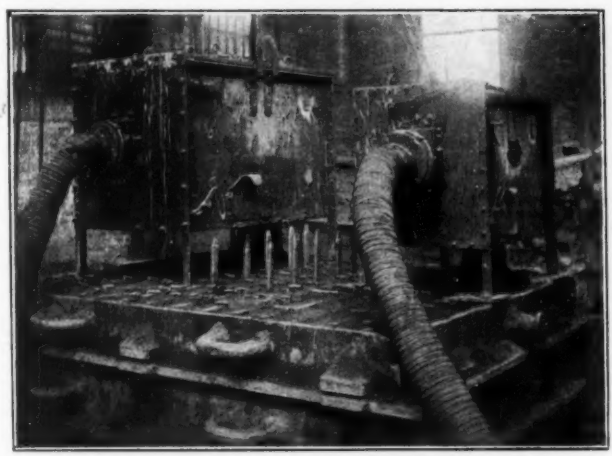

FIG. 1.—SHEDDEN'S MOULD DRYER—GENERAL VIEW.

In the drying of the moulds properly (especially in wet floors), it is necessary that the cold air be sent through the moulds, and then the hot air admitted slowly. By this means the drying of the mould is accomplished in a shorter time, and there is less chance of cracking the mould.

For a full outfit with these furnaces it is necessary to have, first, the power, then a fanner large enough to supply the air necessary for the number of furnaces required; an arrangement of piping, either sheet iron or fireclay, large enough to supply air for whatever number of furnaces might be at work all at the same

time. There must be a suitable number of connections along the entire length of the supply pipe, which must extend the full length of the foundry, so that wherever the furnace is required it can be connected with the main supply pipe by means of a flexible pipe. In foundries where there is electric power, a small direct-coupled electric motor and fan can be coupled to these furnaces and save the inconvenience of laying air pipes round the foundry. The device will dry moulds of any depth, size, or shape, and the cleanliness of the mould, when dried, saves a great deal of time over the old way of drying with open fires. If the mould is very large it is

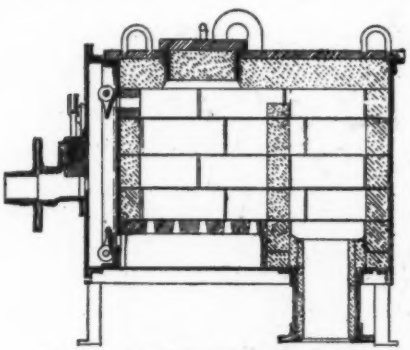

FIG. 2.—SHEDDEN'S MOULD DRYER—SECTIONAL ELEVATION.

advisable to apply two furnaces. The saving all over in fuel is over 50 per cent., and in time from 50 per cent. up to 75 per cent., and the foundry is free from smoke. The working of the furnace is claimed to be so easy that almost any man can be taught in a day. The furnace can also be used to blow hot air into a stove for drying cores.

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DURING the month blast has been turned on to the new furnace at the Blaenavon Iron Works.

THE average selling price of Scotch pig-iron warrants in the Glasgow market for the months of February, March, and April, 1905, was £2 13s. 4½d. per ton.

THOMAS ANDERSON, LIMITED, is the name of a company registered with a capital of £10,000 in £1 shares, to acquire the business carried on at Liverpool, Newcastle-on-Tyne, and elsewhere, by T. Anderson, and to carry on the business of mechanical engineers, etc.

THE BROOKHOUSE SAND MOULDING MACHINE.

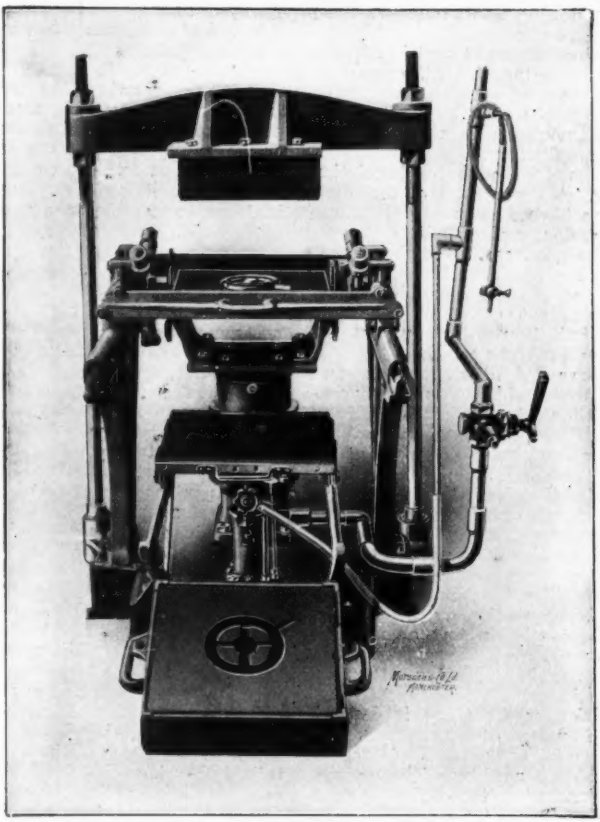
THE Brookhouse moulding machine, which is being placed on the market by Hodgson Hartley, Limited, of Little Peter Street, Knott Mill, Manchester, has many features which render it valuable, not only to the founder who makes large quantities of repetition castings, but also to the one whose greatest run of work does not exceed twenty-five of a kind whose average is not more than six or eight, and who frequently does not make more than one or two at a time. Moulding boxes and pattern plates of any size (within the maximum capacity of the machine) can be used, thus obviating the necessity and expense of having a separate machine for each size of box or pattern plate.

The Brookhouse moulding machine is driven by compressed air, and, in addition to the work of moulding, the air may be, and frequently is, utilised for many other purposes in a foundry.

The operation of the machine is very simple and may be learned in a few minutes. The box, with auxiliary sand box on top, is placed on machine and filled with sand; the box is then pushed under the ramming head, the valve opened, admitting air to the cylinder below, which forces the piston upward, carrying the box to the ramming head, which enters the sand-box and rams the mould; the valve is then reversed, shutting off the air, and opening exhaust, allowing machine and box to descend to its original position (in this operation the sand box is required to prevent the sand flying sideways). The strength of the blow can be readily altered, and the same machine will answer for making moulds for either iron steel, aluminium, or brass. The ramming is done equally all over the mould, the face being hard all over. The patterns are not knocked to pieces by unequal ramming, and there are no splinters knocked off or pieces gouged out of a wooden pattern, as would be the case with hand-ramming.

When the mould has been rammed, the box is withdrawn from under the ramming head, and sand levelled down and the table turned over to draw the pattern. This is done by bringing up a small carriage underneath the box, automatically by the air pressure, and by lowering it slowly by the same means, thus drawing the pattern completely from the mould

in exactly the same manner as in hand-moulding, that is, the pattern is drawn from the sand in the box, not the box lifted off the pattern. This system of pattern drawing is said to be superior to any other, as no trouble is experienced by the sand dropping from the mould when drawing it or after it has been drawn, which is one of the great sources of trouble in many moulding machines, and is a difficulty met with especially in steel foundries, but which is entirely obviated in this machine. Stripping plates are not required, and wooden patterns are frequently used. Patterns may be changed in a few minutes, and can be fitted to or cast on both sides of the pattern plate. If the patterns are plain on one side and only two or three castings are required, the patterns need not be fastened to the plate. Nothing is done to a mould except to place the cores after removing it from the machine—no tooling or mending, and no slicking; consequently all moulds are alike, and all castings the same. This is an important matter in the machine shop, and reduces the cost of machining the castings. No skilled labour is required to work this machine. It can be worked by one handy-man or labourer, who, according to the class of work to be done, can do as much as from four to eight men can do by hand-moulding, making all the time better and more uniform castings and practically no wasters.



THE BROOKHOUSE SAND MOULDING MACHINE.

In connection with the above machine Messrs. Hodgson Hartley, Limited, have compiled the following interesting facts from their experience in the use of sand-moulding machines of various types.

In all sand moulds for metal castings certain conditions are necessary to ensure good results. First, the moulds must be hard enough to withstand the strain from the pouring head without yielding to the pressure of the metal, otherwise the castings will have an uneven surface and will be overweight; second, the mould must not be rammed so hard over the pattern that the gases, generated by the hot metal coming in contact with the sand, cannot escape, or "blowing" will follow and the castings will be unsound.

If the castings are to be neat in appearance and uniform in weight, they must be drawn from the sand without enlarging or breaking the mould.

Successful moulding is the result of avoiding these dangers.

A reference to the above description will show that the system of moulding with the Brookhouse pneumatic moulding machine anticipates the conditions necessary to make good castings economically. Power-moulding machines have been beyond the reach of small foundries on account of their great cost.

Another limitation to power-moulding machines has been their lack of adaptability to boxes of different sizes and shapes. Such machines have been constructed with a view to moulding in a given size and shape of box, often making more than one machine necessary to do the work which might be done with a single machine if universal in its range.

The Brookhouse machine is not limited to any shape or size of box which comes within the maximum capacity of the machine.

This adaptability to different sizes and shapes of boxes will allow a machine to run constantly when a machine limited to one size of box might remain idle much of the time. The importance of this feature in our system is greatest in small foundries, where there is demand for a limited amount of work.

The commercial aspects of the introduction of moulding machines in foundries that are of interest to the entire foundry trade are :—

1. That there should be a reasonable number of castings made from one pattern or set of patterns, and this number will depend on the class of castings and cost of moulding same by hand.

2. Economy in machine moulding is reduced when core setting comprises a large part of the time needed to make the mould, although in such a case the core setting may be done by help independent of the machine.

3. Moulding machines should not be introduced unless they can be given the same care that is given machinery elsewhere. They do not require much, but this little is indispensable if one would get good work from them. They should be oiled occasionally, and never be allowed to get under the sand, as we occasionally see them. Nor should one be considered unless the management is prepared to give it a fair chance in the way of seeing that the sand is properly tempered and the operator otherwise encouraged.

It is often asked : What class of castings are adapted to machine moulding? The answer to this question depends much on the ingenuity and persistence of the pattern-maker, and the force of the management at the back of him. In one foundry indifference may limit the profitable range by one-half, and in another enthusiasm may carry one too far. It is safe to assume that nearly all castings moulded in a two-part box are good work for machine moulding. Irregular joints are as well made on a machine as by hand. When much duplication is called for it is better to have iron patterns. We should keep in mind the fact that one pattern, or set of patterns, used on a machine will give an amount of work equal to the product of from two to ten moulders by hand, and that these machine patterns cost little or nothing in the way of repairs.

What is the profit from machine-moulding, and how is it made? This is the vital question in which all are interested. The gains from machine-moulding are not confined to an increased product per man. Labour with less skill is used. In the sense that the machine operator need have no knowledge of moulding, skill is not required; but, in the broader sense, the expert machineman is skilled to the extent of being apt in his movements, reasonably careful, and knowing just when and how to do it. These qualities as so easily obtained that it makes the labour question comparatively easy. Machine-moulding adapts the foundry to trade conditions. In busy times additional help may be given the machines to increase their production, and in dull times this may be reversed. We must consider machine-moulding, as it is applied to the average foundry, without surrounding advantages. There is no reason why the moulding machine should not do for the foundry just what the milling machine and turret lathe have done for the machine-shop. We believe it will, and the founders who have advanced in this direction agree with us.

NOTES ON THE FOUNDRY.*

A most important branch of metallurgical work, until recently conducted on empirical lines, is that of the foundry, whether for iron or steel.

As far back as 2000 B.C. the ancient Egyptians were making bronze castings by the *cire perdu* process, the moulds being of loam, much as they are now.

There is need for better systems of keeping cost. Much absurd and ruinous competition in foundry productions would cease if due attention were paid to this subject. There is also need for the education of foundrymen. This side of technical industry has hitherto been relegated far too much to chance. No one wishes to decry the value of experience, but there is no reason why ordinary foundry managers and foremen should not occupy a position equal to that of the mechanical engineer. Facilities should be given to foundrymen to study the principles of their craft at technical schools. Their knowledge should extend to the composition and analysis of pig-iron and other stock used, to the control, on scientific lines, of moulding methods; they should have a knowledge of foundry sands and compositions used in the moulds, and, finally, they should acquire full information upon the mechanical properties and qualities of the articles produced. The recent suggestion, made in America, of having a training school for foundry foremen, with a view to increasing their knowledge in mechanics and metallurgy, is an excellent one. The idea put forward is that a small foundry should be established entirely as a school or training-ground for foremen and superintendents.

Cast Iron.

Scientific Management.—The excellent work done many years ago by Professor Thomas Turner in England in investigating the action of silicon upon cast iron, and by Professor Ledebur, in Germany, on the condition of carbon in malleable iron castings, represents the first important modern effort to bring about systematic improvement in this direction by the application of scientific management in the production of cast iron.

The American Foundrymen's Association, largely influenced by Moldenke, West, Flagg, Keep, Outerbridge, Field, and others, have also most vigorously pushed forward systematic and scientific observation and research in cast iron and foundry work. By taking in hand vigorously the chemistry of cast iron in foundry practice it has been shown, especially in America, that the old systems of working must be cast aside, to be supplanted by scientific methods once unthought of. It may be noticed, therefore, with great satisfaction, that similar steps are being taken in this country to improve the technical side of this long-neglected industry.

Technical journals published specially for the founder are pushing on the good work in America, England, France, and Germany, to the great benefit of all concerned.

More attention is now paid to the chemical composition of pig-irons used for producing castings. The old and often misleading idea of working by fracture has been found to be quite unsuitable for modern requirements.

Steel Castings.

This important branch of steel production is an industry which has practically sprung up within the last forty, certainly within the last fifty, years.

Early Attempts.—Germany claims that Jacob Meyer, the first technical manager of the "Bochumer-Verein," an establishment founded in 1843, was the first to make steel castings in moulds, producing cast steel church bells in 1851.

It is also said that the first furnace for the manufacture of crucible cast steel was that constructed by Krupp in 1811.

The "Essener Gusstahlfabrik" took up this industry in 1862, casting disc-wheels and railway crossing-pieces in fairly hard crucible steel. In 1867 the open-hearth furnace was introduced. A 9-ton propeller-blade was cast of steel in 1872 for the Hamburg-American Steamship Company.

The introduction into this country of the manufacture of steel castings on a systematic basis was made by Vickers, and appears to have come from Bochum, in Germany, about the year 1856. The information imparted in the Riepe composition for moulds enabled a commencement to be made in this art. It is singular that the first product of the industry was through its application to the casting of steel for bells—articles about as far removed as possible from useful mechanical purposes. A special advantage claimed for steel bells was that they were only one-third the weight of those cast in bronze.

Mr. John Mallaband, who was in the works of Messrs. Vickers during the early days of their manufacture of steel castings, has often told me of the many difficulties which were experienced, and which were only overcome by great perseverance.

* From Mr. R. A. Hadfield's Presidential Address before the Iron and Steel Institute.

About 1868 cast steel propellers and their blades were first introduced, and shortly afterwards the manufacture of hydraulic cast steel cylinders was commenced. Great difficulty was experienced, as but little practical help was then afforded by laboratory analysis or mechanical tests. Wasters were common, and many firms were ruined or lost large sums in connection with this industry. For example, it may be mentioned that a firm well known to me was asked to make hydraulic cylinders for cotton presses. These were required to be of long lengths, 15 to 20 ft., to have only thin walls, about 2 in. in thickness. Very fluid steel was necessary to pour these, and a hard mixture was selected, the actual analysis at the time being unknown. A modern analysis of a specimen of the material showed the carbon to be nearly 1.50 per cent. Whilst such a material was strong enough in tensile strength, naturally, when it was annealed to obtain the necessary toughness, a considerable portion of the large content of carbon separated out as graphite, so that when hydraulic pressure was applied to the cylinders the water oozed through the walls as through a sponge. Ruin almost stared this firm in the face, for many thousands of pounds were lost before the reason of the defect was discovered and the proper remedy applied. This is only one of many instances of the great difficulties experienced in the early days of the steel-casting industry.

It was at the great Exhibition in Paris, 1878, that a further remarkable advance, made possible by the Terre Noire Company's investigations, was shown. Their wonderful display of complicated casting work in steel deserved more recognition than it received at the time. I have elsewhere mentioned Euverte and Pourcel, the directors of the works, and to them our gratitude is due, for they freely gave to the world the results of their labours. Their investigations led not only to great advances in the art of producing steel castings, but also to more systematic research in other directions bearing on special steels and their treatment.

There seems always to have been a glamour over the practice of steel casting. Probably more heartbreaking and disappointment have occurred in the exercise of this art than in any branch of steel industry; partly because those entering into the arena have been totally unaware of the many difficult conditions and problems that had to be overcome. Cast iron and cast steel have seemed to many almost the same, and only after bitter experience has their great difference been discovered. The ease with which steel could be produced on a large scale for ingots, when probably half-a-dozen or a dozen large ingots used up a whole heat gave no foretaste to early workers of the extraordinary difficulties in pouring a heat of the same steel into many separate castings. The want of fluidity caused much trouble, and wasters by the score were produced. Then, too, the great contraction, double that of cast iron, which had to be dealt with, added to the difficulty of obtaining castings free from cracks; to say nothing of the apparently intense desire of fluid steel, when poured into a sand mould, to assume that beautiful honeycombed form so sadly familiar in earlier days.

Later Progress.—Happily, however, many of these difficulties have been overcome; and though the industry is still one requiring more than usual care and skilful management, the satisfactory advances made during the last decade have been of the highest importance.

The great advantages derived from the use of aluminium and silicon, as solidifiers, have enabled most of the defects due to unsoundness to be overcome. Increasing knowledge of the analyses and qualities of the various sands and fire-resisting materials used in moulds has been equally important. A range of product varying from that having a ductility almost equal to that of soft forged steel up to the hardest type is now readily obtained.

Many of the difficulties still met with would be largely overcome if the engineer would consult the steel founder when preparing his designs and patterns. Slight differences in design will ensure the production of a casting in steel which could not otherwise be satisfactorily made; in other words, the steel may be of the best, the mould properly prepared, and yet all be entirely spoiled by failure to appreciate the necessity for adapting, as far as practicable, the design of the article required to suit the peculiar nature of fluid steel.

Amongst early British workers in the advancement of this branch of industry, the names of Attwood and his partner, Rogerson, of Spencer of Newburn, and Osborn of Sheffield, should be mentioned.

Besides England, Germany, and France, America has contributed a considerable share to the present importance of this great industry. Since 1867, when the William Butcher Steel Company (now the Midvale Company), an offshoot from a Sheffield firm of the same name, first introduced the manufacture of steel cast-

ings into the United States, very great development has taken place. In 1903, 430,000 tons (the capacity is now claimed for no less than 1½ million tons) of steel castings, largely basic, are stated to have been turned out. The competition there has been ruinous, and many losses are said to have taken place, so that the industry cannot be entirely on a satisfactory footing.

As an example of the difficult castings now produced, my firm recently made a number of hydraulic cylinders 30 ft. in length, with walls only 1¾ in. in thickness, the contraction in the moulds, on this length, amounting to the very considerable figure of 7½ in., that is, the mould had to be 30 ft. 7½ in. in length to produce a casting of 30 ft.

Testing.

A few words may be devoted to the important branch of our work which consists of testing material in its various stages of production.

Present Methods.—Whilst the consumer is entitled to satisfy himself that he is receiving what he pays for, it is a great question whether some of the rigid inspection now practised does not do more harm than good. After all, a manufacturer's reputation is the buyer's best protection, and there are few firms who would knowingly send out bad material. If the maker and those who formulate specifications could be brought more closely in touch, much trouble and anxiety to everyone concerned would be avoided.

Standardisation.—It is for this reason that the Engineering Standards Committee, which has been at work for the last two or three years, ought to prove of value if its efforts are properly sustained and due co-operation is obtained between users and makers. Our American cousins have congratulated us warmly upon the strides we have made in this country. If a British, American, and Continental Association (each country has its own division at the present time) could now be permanently combined for the unification of all tests, there is no doubt the step would be of immense value. The International Testing Association has also carried out good work in this direction largely due to the labours of the late Professor Tetmajer.

Excellent work on specifications and testing has been done in America by Dr. C. B. Dudley, Mr. Kreuzpointer, Mr. A. L. Colby, Mr. R. W. Hunt, and many others. In this country we have to thank Professor Unwin, Dr. Kennedy, Mr. F. C. Fairholme, Mr. Kirkaldy, and Professor Arnold, amongst others, for what they have accomplished in this field.

There has been much discussion in America as to the adoption of one specification for structural steel, and whether a "one grade" steel, having a tensile strength of from 28 to 38 tons per square inch, is desirable, and the question has been raised whether such a steel is equally suitable for structural purposes as that of a softer nature. There has not been such division in this country, so that our policy and that of the Continent are practically being generally adopted.

Whilst, no doubt, inspecting engineers have delicate and difficult work to perform, it would appear that there are often cases where, owing to the many controlling circumstances, the manufacturer's lot is not a happy one. It may seem a bold thing to say, but the consumer would probably not be one whit the worse off, and often a great deal better off, if much of the testing now carried out were modified or dropped. In any case, some of the specifications at present drawn up are most unwise in the buyer's interest, to say nothing of their unreasonableness. Should not more trust be placed in makers of repute? The old proverb, "Rule by love rather than by fear," is one that could be well applied to the case in question. Much of the money spent on inspection tests would be better employed if devoted to research work, for the purpose of helping, rather than hindering, manufacturers.

Shock Test.—Whilst the tensile test continues to be of great service, new forms of testing are coming to the front. It is found that the ordinary tensile bar does not entirely show the special qualities of the material as regards its resistance to shock. Mr. Fremont, in France, has been largely instrumental in bringing forward this important question; and without doubt an additional means of testing, such as the impact or shock test, does impart much valuable information, both to the maker of the steel and the user. The test, whether termed "impact," "shock," or "alternating," aims at the same result, that is, to ascertain whether a particular material resists shock and vibration. There is no doubt that under certain conditions steel which is apparently in good form for elongating under steady tensile stress may not, in some cases, have its internal crystallisation or structure sufficiently interlocked to stand a rapid or sudden shock or vibratory stress. Therefore, and means which will help us to detect such differences must prove of great

benefit, as the difficulty, once detected, can be overcome by suitable heat treatment or by modified composition of steel.

Dr. P. H. Dudley, in a paper on "Rails for Lines with Fast Trains," when speaking of drop tests, says that it has been found in the Bessemer process when these tests are made promptly, the conversion of the steel can be checked within a few hours, and slight corrections necessary to be made in the chemical composition, due to changes in the weather, can be made. He also states the somewhat remarkable fact that "The drop test will detect instantly a reduction in the percentage of manganese in the steel due to the approach of a storm."

Fragility Tests.—Mr. H. Le Chatelier in one of his papers has recently dealt with this important question. He gives credit to Mr. Considère and to Mr. André Le Chatelier for having drawn attention to this important question about fifteen years ago. He describes the special fragility sometimes noticed in steel by a clever phrase, "Some steels present intermittent fragility." This is very expressive. He shows how in the past we have invoked all sorts of explanations for this peculiarity, such as local defects, bad composition, and the like, whilst the peculiarities noticed were really due to the physical condition of the material; one in most cases easily changed by correct heat treatment.

He indicates how readily this fragility is detected by shock tests on nickel or notched bars. By varying the depth of the nick, either a fibrous or granular fracture can be obtained. Annealing and heat treatment afford an important remedy. He finally sums up by pointing out that we must not now run to the other extreme and imagine that all tests upon a metal can be reduced to fragility tests. Hardness, elastic limit, and other qualities are not less important according to the use to which the material is to be put. He thinks, however, that for many purposes the ordinary tensile tests, bending tests, and even stipulation as to chemical composition, will eventually disappear from specifications.

Hardness Tests.—Reference should be made to Brinell's method of determining the hardness of metals by means of pressing a hard steel ball into the material to be tested and measuring the spherical area of the cavity produced. His system has been found of great service, comparison of hardness being quickly and cheaply obtained. We are greatly indebted to him for this simple but effective method.

NEW FOUNDRY OF MESSRS. ERNEST SCOTT & MOUNTAIN.

Messrs. Ernest Scott & Mountain, Limited, have recently opened new works at Gateshead, the site being the old works of Messrs. Black, Hawthorn & Company, which Ernest Scott & Mountain purchased in 1904. Part of the old shops have been utilised and extended, and, with the new shops which have been erected, a very modern and up-to-date factory of large capacity has been secured.

These new works are situated adjoining the North-Eastern Railway from Newcastle to Sunderland, are within six minutes' walk of Gateshead Station, and their total area is nearly seven acres, two acres of this being under cover. A direct siding is provided to the North-Eastern Railway, and full gauge tracks are laid throughout the works, so that inward and outward material can be handled without transhipment and at a minimum of cost. The total length of railroad for siding and through the works is approximately a mile.

On entering the offices, the visitor is shown into the large waiting-room, from which access can be obtained to the offices themselves or direct into the works. The offices adjoining this room comprise caretaker's rooms and kitchen; large dining-room for the staff, capable of seating comfortably forty people; breakfast and reading-room for the pupils and visitors; filing-room for correspondence in all departments; stationery store; photographic printing room; drawing office and the offices of the commercial and technical management. Opening out of the waiting-room is the time office, through which the whole of the workmen pass on entering and leaving the works, and adjoining this is the large workmen's dining-room, where accommodation is provided for overcoats, and in which there are tables and seats for those who prefer to eat their meals at the works instead of going home.

The machine shops are in four main bays. The business of the company is now largely the manufacture of electrical machinery, but pumps, engines, and auxiliary machinery for warships are also manufactured.

The foundry, which has every facility for turning out the best quality of work, is 175 ft. long by 112 ft. wide, giving a floor space of 18,000 sq. ft. There are two cupolas, with a combined capacity of 11 tons per hour. The air blast is sup-

plied by a Root's blower, driven by a 52 h.p. electric motor, which also operates the loam mill and the hoist for carrying the materials on to the cupola staging. At the back of the cupolas are a number of bins, over which a siding is carried, so that the foundry materials can be deposited inside the building with a minimum of trouble. The brass foundry, which is under the same roof, comprises four pot-holes and a small drying stove of its own, and this department is served by means of a hand telfer, which supplements the 15-ton electric crane in the main bay. The light moulding is carried out in a small bay at the east side of the foundry, which is also used for the storage of some of the foundry boxes.

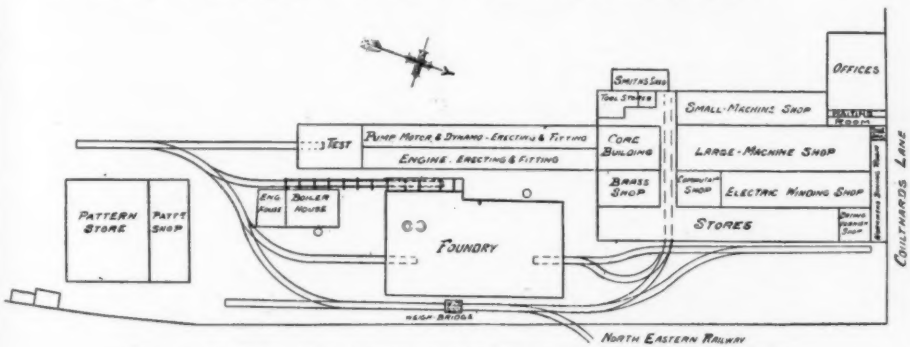


FIG. 1.—PLAN OF NEW WORKS OF MESSRS. ERNEST SCOTT & MOUNTAIN.

Pattern Shop.

A short distance from the power house are the pattern shop and pattern stores, which consist of three bays in one building, with a dividing wall between the stores and the pattern shop, the length of this department being 100 ft., and the width 120 ft. The pattern shop is espe-

FIG. 2.—GENERAL VIEW OF FOUNDRY.

cially fitted up for turning out the class of patterns required in this business, and the ordinary lathes, saws, planing machines, etc. There is a total of 25

FIG. 3.—ANOTHER VIEW OF FOUNDRY.

FIG. 4.—PATTERN SHOP AND STORES.

the equipment includes a large number of up-to-date wood-working tools, as well as machines in this shop, which will show that the aid of machinery is largely

sought in the construction of patterns in a modern works. The main shafting driving this machinery is carried in a pit underneath the floor, the belts being run up to the various machines, which stand on each side of the pit. This arrangement prevents any interference with the light, and allows freedom of access to the machines from all directions.

The power for driving this department is supplied from an electric motor of 40 h.p., which is placed in a glass-panelled screen to minimise the risk of fire. The adjoining pattern stores have a total floor area of 8,000 square feet, and are well equipped with racks and frames for

The electric current for the various departments is supplied from the generating station; but mains from the Gateshead Electric Supply Station are laid in, and power is taken from this source to supplement the electricity generated by the firm's own plant. Electric motors operate the whole of the shafting in the various departments, these motors being placed in such positions that they will not interfere with the general working of the machinery. A total of 42 motors are provided in the shops, the total horsepower of these machines being 400. The artificial lighting in the works is by means of arc lamps, each of 1,000 candle-

FIG. 5.—INTERIOR OF PATTERN SHOP.

dealing with the various kinds of patterns. The pattern shop and stores are on slightly higher ground than the rest of the works, and by taking a few steps to the east after leaving this building, the highest point of ground on the estate can be reached, from which a good view is obtained of the general arrangement of the works and the various shops. From this position it will be seen that ample space remains for all future extensions, and it will also be observed that the works have been so designed that these extensions can take place at any time without interference with the continuous working of the present shops, and at a minimum of expense.

power, the total number installed being 72. A very large number of incandescent lamps is also provided for separate tools, offices, etc. The heating of the shops is done by live steam, which is carried throughout the whole of the buildings in specially constructed pipes with radiating gills. The erection of the new shops and the general laying out of the works have been carried out to the designs and under the superintendence of Mr. W. S. Vaughan, of Messrs. Vaughan & Dymond, of Newcastle-on-Tyne.

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THE REED ELECTRICAL COMPANY have established a branch at 24, Charles Street, Bradford.

AIR BLAST FOR THE FOUNDRY CUPOLA.*

THE foundryman about to instal a blower for his cupola wishes to weigh carefully the relative merits of the fan and the positive blowers. The data to be considered in order of their importance are as follows:—First, the relative advantages in operation; second, the relative efficiency, *i.e.*, the relative power required for operation; third, the relative costs of maintenance; fourth, the comparative first cost.

Operating Advantages of Fan.

The principles upon which these two types of blowers operate are quite different. The centrifugal blower furnishes a variable air volume at a constant pressure, while the positive blower furnishes a constant volume and variable pressure. Which method offers the greatest advantage in the operation of a cupola is still a matter of dispute among foundrymen. It is urged by the advocates of the positive blower that a positive air volume gives a greater speed of melting with less power for a given pressure. Others base their preference for the fan upon the claim that it is more elastic in its operation giving a greater volume of air when most needed at the beginning and at the end of the heat, and at no time forcing the cupola to an undue extent. It is maintained further that the fan has the advantages of permitting a complete control of the blast volume and pressure through the operation of the blast gate, a feature which is impossible in the positive blower without great waste of power. The expert cupola operator watches the speed of melting very carefully: and with the fan blast always has it under ready and perfect control. The melting capacity of the fan depends upon the inside diameter of the cupola and upon the pressure, while the melting capacity of the positive blower depends upon the speed. Thus it is common in fan practice to increase the melting capacity by increasing the diameter of the cupola inside the lining without changing the speed of the fan. With the positive blower, however, it would be necessary either to increase the speed of the blower or to instal a larger size.

Flexibility of Fan Blast Saves Power.

An advantage is claimed for the positive blower in the consumption of power. Under certain conditions a slight superiority in power economy of the positive blower over the fan cannot be denied. Neither is mechanically perfect. In the former, loss of power and of air volume occurs principally through leakage of air between the contact surfaces of the rotary parts. There is considerable loss also due to the friction of the contact parts and of the gearing. The loss in power in the fan is due chiefly to the loss in pressure by friction of the air in passing through the blower. A new positive blower in good condition will give an efficiency of from 70 to 75 per cent., while the fan as usually constructed gives an efficiency of only 60 to 65 per cent. At a slightly increased cost, however, fans can be built giving not less than 70 per cent. efficiency, or practically the same efficiency as obtained by the positive blower. The wearing of the contact parts in the positive blower causes a rapid decrease in the efficiency, so that after some years' service its efficiency is frequently lower than that of the fan. While under ideal conditions the positive blower gives slightly better efficiency than the fan, yet under practical conditions of operation the fan usually proves superior, owing to the great flexibility of its blast.

An erroneous impression is often given as to the power required for fan blast, owing to the fact that very often fans are not properly proportioned for the duty required. The efficiency of the fan decreases when the fan is worked either above or below its rated capacity, although the change in power is not so great as with the positive blower. With the positive blower the power increases or decreases with the pressure, while with the fan, the air volume and the power are less as the pressure increases and grow more as the pressure decreases. On this account a fan frequently requires excessive power when proper attention is not given to the regulation of the blast, especially when starting the cupola or blowing upon the fire, and also toward the end of the heat when the bed of fuel becomes light. This subject was discussed by Mr. Thomas D. West in a paper read before the Pittsburg Foundrymen's Association. The great amount of power used by the fan which he cites was required when blowing up the fire before charging the cupola. Under these conditions the power required is two or three times that necessary under normal conditions of operation. As a motor was used the speed of the blower could not be changed, and the power should have been reduced by

* Paper by Mr. W. H. Carrier, of the Buffalo Forge Company, before the Buffalo Foundrymen's Association.

the use of a blast gate. In this connection, it should be stated that a cupola fan requires approximately seven times as much power when blowing freely into the atmosphere as when operated at the same speed with the outlet closed.

Lower Pressures Favoured.

The writer believes the practice to be growing in favour among foundrymen of using lower pressures and larger tuyere area with the better distribution of blast. Under these conditions the advantages lie largely with the fan. As a comparison, a local foundry using a positive blower on a 60-in. cupola at 16½ oz. pressure requires three horse-power per ton of iron melted per hour, while in another case a fan operating a 66-in cupola pressure requires 2¼ horse-power per ton of iron melted. The blower and fan were both new. It is also interesting to note that the former requires a ratio of 8 to 1 for melting, while the latter requires a ratio of only 10 to 1. The reason for this difference in melting ratio is shown, in part, by a comparison of the analyses of cupola gases. Gases from the first cupola gave the following analysis: Carbon dioxide, 11.5 per cent.; carbon monoxide, 11.4 per cent.; oxygen, .5 per cent.; nitrogen, 76.6 per cent.; pounds of air per pound of carbon, 8.9 per cent.; heat units per pound of carbon, 9,200.

In the second cupola using a fan, the following analysis was taken: Carbon dioxide, 15.1 per cent.; carbon monoxide, 8.7 per cent.; oxygen, .3 per cent.; nitrogen, 76.2 per cent.; pounds of air per pound of carbon, 9.4 per cent.; heat units per pound of carbon, 10,800.

From this it will be seen that 15 per cent. more heat was obtained from the fuel in the second case than in the first, which accounts in part for economy shown by the melting ratio. Unfortunately the temperatures of the iron, which are required to make the above data complete, were not taken, but it is believed that they were practically the same, in each case being sufficient for pouring a good grade of fine castings. The fact that there is a greater difference in the melting ratios than would be indicated by the gas analysis may be accounted for by the hypothesis that, owing to the more uniform distribution of the blast at a lower pressure in the second case, there was a greater concentration of heat, and, consequently, a high temperature in lower part of the melting zone; while in the first instance with less perfect distribution of blast and with higher velocities, the melting zone was more extended and the temperature in the lower part less intense.

The combustion in the cupola is always imperfect. A large volume of carbon monoxide indicates a waste of fuel and a lowered temperature. In the second case a centre tuyere cupola was used, which, with the low pressure, gave a very even distribution of the blast. It would appear that the proper distribution of the blast is the most important feature of cupola operation and affects the economy of fuel, the time of melting and the horse-power required in furnishing blast.

Melting Capacity.

A question of much importance is the melting capacity of various sizes of cupolas under different pressures and the corresponding horse-powers required for operation. As the result of numerous tests and considerable investigation, a relation has been formulated between the size of the cupola, the pressure of the blast, the average speed of melting and the horse-powers required for operation. These data are given completely in the accompanying table. The figures on the left represent cupola diameters, and those at the top, static pressure at the cupola in ounces per square inch:—

Table of Cupola Capacities.

		10 oz.	12 oz.	14 oz.	16 oz.
30 in.	Cap. ...	5,690	6,230	6,730	7,200
	A.P.M. ...	423	1,568	1,688	1,800
	H.P. ...	17.4	9.7	12.3	15.0
35 in.	Cap. ...	7,740	8,480	9,170	9,800
	A.P.M. ...	1,935	2,120	2,293	2,450
	H.P. ...	10.0	13.2	15.7	20.4
40 in.	Cap. ...	10,120	11,080	11,970	12,800
	A.P.M. ...	2,530	2,770	2,993	3,200
	H.P. ...	13.2	17.3	21.8	26.6
45 in.	Cap. ...	12,810	14,030	15,150	16,200
	A.P.M. ...	3,203	3,508	3,788	4,050
	H.P. ...	16.7	21.9	27.6	33.7
50 in.	Cap. ...	15,810	17,320	18,700	20,000
	A.P.M. ...	3,953	4,330	4,675	5,000
	H.P. ...	20.6	27.0	34.0	41.6
55 in.	Cap. ...	19,130	20,960	22,640	24,200
	A.P.M. ...	4,783	5,240	5,660	6,050
	H.P. ...	24.9	32.7	41.2	50.3
60 in.	Cap. ...	22,770	24,940	26,940	28,800
	A.P.M. ...	5,693	6,235	6,735	7,200
	H.P. ...	29.6	38 9	49.0	59.9
65 in.	Cap. ...	26,730	29,270	31,620	33,800
	A.P.M. ...	6,683	7,318	7,905	8,450
	H.P. ...	34.8	45.7	57.5	70.3
70 in.	Cap. ...	30,990	33,950	36,670	39,200
	A.P.M. ...	7,748	8,488	9,168	9,800
	H.P. ...	40.3	52.9	66.7	81.5

The diameter of the cupola given is inside the lining. The first figure gives for

each size the capacity in pounds of iron per hour and is marked Cap., the second figure gives the cubic feet of air per minute required and is marked A.P.M. The third figure gives the horse-power required for operation of fan and is marked H.P. It should be noticed that the melting capacity increases at a much lower rate than the pressure, while the horse-power increases very rapidly with the increase in the speed of melting. For instance: A cupola 60-in. inside lining will melt on an average 11½ tons per hour at 10 oz. pressure with 29½ horse-power. The same cupola requires 16 oz. pressure and 60 horse-power to melt 12½ tons per hour.

Fan More Economical.

The cost of the maintenance is, perhaps, about the same with either type of blower. With the fan the only cost of maintenance is that of replacing belting and rebabbitting of bearings, neither of which is required more than once in several years. Apart from this there is practically nothing about the fan that can wear out and impair the efficiency. With the positive blower the chief wear is in the contact surfaces which causes a decrease in the capacity and efficiency, and finally renders the blower worthless. As the first cost of a positive blower is much greater than that of the fan, the loss through deterioration is consequently greater.

Compound Blowers.

Some very interesting experiments have recently been made in compounding of blowers for higher pressures. The Buffalo Forge Company is now constructing a compound blower which gives two pounds pressure per square inch. It has been found by tests that the efficiency of the blower is not affected by the pressure, so theoretically there is no limit to the pressure that may be secured. By sufficient compounding, a fan could be used as a substitute for an air compressor or blowing engine and efficiency as high as 70 per cent. secured. It is probable that great progress will be made in this direction within the next few years by the use of compound fans direct connected to steam turbines.

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THE GREAT NORTHERN RAILWAY COMPANY are about to experiment with two new four-cylinder compound express passenger locomotives of the "Atlantic" type, which has no fewer than four cylinders placed abreast, but driving on to separate axles.

PERSONAL

SIR CHARLES METCALF has of late been somewhat seriously indisposed.

THE late Mr. E. Eaton, of Sheffield, retired steel manufacturer, left estate valued at £8,497.

MR. W. CLEAVER has been appointed chief engineer to the Port Talbot Railway and Docks Company.

MR. S. J. ROBINSON, a director of William Jessop & Sons, Limited, will be the next Master Cutler of Sheffield.

MR. J. GAVEY, engineer-in-chief to the Post Office, has been elected President of the Institution of Electrical Engineers.

THE late Mr. S. Smith, ironfounder, of Smethwick, Staffs., left estate of the gross value of £12,890, of which the net personalty is £6,485.

MR. T. MILLER has been appointed a managing director of Gourlay Brothers & Company, Limited, engineers and shipbuilders, Dundee.

MR. D. GARDNER, the Scottish representative on the Council of the Amalgamated Society of Engineers, has been re-elected President of the Society.

MR. W. F. COAKER, works manager to Ernest Scott & Mountain, Limited, has been the recipient of a presentation from the officials and men on the occasion of his recent marriage.

MR. E. CARLISLE, manager of Messrs. Cammell, Laird & Company's works, and two directors of the concern, recently returned from Spain, where they have been for some time on business.

PROFESSOR H. M. HOWE, of New York has been elected foreign correspondent of the Society for the Encouragement of Industry of Paris, in succession to the late Sir Lowthian Bell.

MR. G. P. NAYLOR, who superintended the laying out of coke plant at Messrs. Bolckow, Vaughan & Company's Dean and Chapter Colliery, Ferryhill, has been appointed to another engineering position at the Eston Steel Works.

MR. PERCY LONGMUIR—Carnegie Research Scholar, 1902-4, and late of the National Physical Laboratory—informs us that he has commenced practice as a metallurgist and metallographist at 30, Coleshill Road, Teddington, S.W.

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THE DELTA METAL COMPANY, LIMITED have removed from 110, Cannon Street, London, S.E., to East Greenwich, London, S.E.

TRADE TALK.

THE DARLINGTON WAGON AND ENGINEERING COMPANY, LIMITED, is being wound up voluntarily.

RICHARDS & HOPKINS, LIMITED, of Caerleon, contemplate carrying out extensions at their foundry.

THE BRUSH ELECTRIC COMPANY, of Loughborough, have lately re-modelled several of their shops.

MR. P. A. POSTLETHWAITE, metallurgical chemist, has removed to 2, Union Court, Old Broad Street, E.C.

THE GRAHAM ROBINSON STEEL COMPANY, LIMITED, has been registered with a capital of £15,000 in £1 shares.

THE plant, etc., at the Stirchley Iron Works, Dawley, Salop, will be offered for sale by public auction during June.

MR. H. ALLEN has started business at Central Chambers, 17, Cheapside, London, E.C., as a metallurgical chemist, etc.

AN official reduction has been declared in Lincolnshire pig-iron of 1s. and 1s. 6d. per ton respectively in foundry and forge.

THE works of the York Engineering Company, Limited, in voluntary liquidation, are being offered for sale by private treaty.

THE purchase of the Lowther Iron Works, Workington, by Cammell, Laird & Company, Limited, is now officially reported.

THE NATIONAL GAS ENGINE COMPANY, LIMITED, comtemplate the erection of an extensive foundry at their Ashton-under-Lyne works.

A VESSEL arrived at Maryport recently from Rotterdam with 1,500 tons of German coke for Cammell, Laird & Company, Limited.

REDPATH, BROWN & COMPANY, LIMITED, have removed their Manchester offices from Adelphi Street, Salford, to Trafford Park, Manchester.

THERMAL ENGINE COMPANY, LIMITED, is a new company which has been registered with a capital of £3,000 in £1 shares (1,000 preference).

MR. A. HALLAND, of Farnworth, Lancs., who traded as the Electric and Mechanical Enginering Company, has been adjudged bankrupt.

A FIRE broke out recently at the Islington Tube Works, Birmingham, belonging to William Bayliss, Limited, and considerable damage was done.

MR. E. J. DUFF announces that he has commenced business as a consulting engineer for gas power installations, at 51, South John Street, Liverpool.

A CONCERN has been registered, under the title of the Weighing Machine and Engineering Company, Limited, with a capital of £8,000, in £1 shares.

MESSRS. W. B. BARR & GOURLAY, of 53, Bothwell Street, Glasgow, have been appointed Scottish agents for the Hardy Patent Pick Company, Limited.

MESSRS. G. R. LUDWIG AND W. YOUNG, engineers, etc., Long Eaton, Derbyshire, trading under the style of Ludwig & Young, have dissolved partnership.

MESSRS. A. FERGUSON and J. BAIRD, shipbuilders, etc., Connah's Quay, Flintshire, trading under the style of Ferguson & Baird, have dissolved partnership.

NAPIER & MILLER, LIMITED, the well-known Yoker shipbuilding firm, have now secured ground at Old Kilmarnock, on the Clyde, for their new shipbuilding yard.

THE Hammersmith Borough Council have placed an order with Mr. Wm. Boby, of Salisbury House, London Wall, E.C., for one of his heater-detartarisers.

THE new American blast furnace at the works of the Frodingham Iron and Steel Company, Limited, has now been completed, and the furnace has been lighted.

MR. E. SHRAPNELL SMITH has disposed of his consulting practice in heavy motor transport to Mr. D. Mackenzie, of Cecil Chambers East, 86, Strand, London, W.C.

THE new dock at Clydebank will soon be available for ordinary shipping purposes, and will be very convenient for Messrs. John Brown & Company's shipyard.

RICHARDSONS, WESTGARTH & COMPANY, LIMITED, have decided that in future the dividend on the ordinary shares will only be paid after it is declared at the annual meeting.

CONSIDERABLE improvement is being made to the dock on the Clyde of the Fairfield Shipbuilding and Engineering Company, including the widening of the entrance from 100 ft. to 240 ft.

IN reply to Mr. J. F. Hope, in the Commons, concerning armour plate for the navy, Mr. Pretyman has stated that the next orders for armour plate would probably be out in about a month.

MR. W. A. TOOKEY, the author of handbooks on "Gas Engines," "Oil Engines," and "Gas Producers," has established himself at 29, Old Queen Street, Westminster, S.W., as an engineer.

THREE locomotives ordered in February by the Swansea Harbour Board from Andrew Barclay, Sons & Company, Limited, of Kilmarnock, were, we understand, turned out in ten weeks.

WELCH, BENHAM & COMPANY, LIMITED, have been registered with a capital of £4,000 in £1 shares, to acquire the business carried on at Bell Lane Iron Works, Wandsworth, as Paisley & Welch.

DOUGLAS, FRASER & SONS, LIMITED, have been registered with a capital of £80,000, in £10 shares, to acquire and carry on the business of Douglas, Fraser & Sons, engineers, etc., Arbroath.

LOCKWOOD BROTHERS, LIMITED, filemakers, etc., of Spital Hill, Sheffield, have just completed the re-modelling of the whole of their works by the introduction of the newest types of machinery.

WILLIAM NEWSOME & SON, LIMITED, have been formed, with a capital of £6,500 in £1 shares, to acquire the engineering business carried on at Sowerby Bridge, Yorkshire, as William Newsome & Son.

MR. A. WOODFIELD, who was recently connected with the engineering firm of Messrs. Woodfield & Company, Chapel Street, Luton, has started business on his own account as an engineer at Luton.

WM. BEARDMORE & COMPANY'S ship building yard at Govan was offered for sale by public auction at Glasgow recently at the upset price of £110,000, but was eventually withdrawn, there being no bid.

SPURR, INMAN & COMPANY, LIMITED, Calder Vale Boiler Works, Wakefield, have appointed Mr. J. J. Huntley, of 4, St. Nicholas Buildings, Newcastle-on-Tyne, as their agent for the North of England.

THE ENGINEERING STANDARDS COMMITTEE have during the month issued their reports on British Standard pipe threads for iron and steel pipes and tubes, screw threads, and structural steel for shipbuilding.

THE vessel which arrived at Newport recently with a cargo of American iron and steel from Baltimore, has taken a cargo of pig-iron turned out from the furnaces of the Blaenavon Company back to Baltimore.

THE Belfast concern of Coates & Company, Limited, engineers and boilermakers, Prince's Dock, and Lagan Bank, has been dissolved, and a break-up sale by auction has been ordered by the Irish Rolls Court.

THE proposal to hold the fourth congress in connection with the International Association for Testing Materials at St. Petersburg this year has been abandoned The fourth congress will be held at Brussels in 1906.

SIR DOUGLAS FOX and partners, the consulting engineers to the Rhodesian Railways, Limited, have announced that the bridge at Victoria Falls will be completely riveted, painted, and finished by the middle of June.

SUBSCRIPTIONS have been invited at par for 10,000 of 6 per cent. cumulative preference shares of £5 each in Bruce Peebles & Company, Limited. All the proceeds of the issue will be applied to the extension of the company's works.

WILLIAM GRAY & COMPANY, LIMITED, the well-known shipbuilders, of West Hartlepool, have lately made an issue of first mortgage debentures. The issue consisted of 3,500 4½ per cent. first mortgage debentures of £100 each at par, or £350,000.

DURING last year important additions were made to the plant of Henry Pooley & Son, Limited, at their Kidsgrove Works, including the partial application of electric driving plant. Freehold works have lately been bought at Smethwick, Birmingham.

A NEW blast furnace, recently erected at the works of the Parkgate Iron and Steel Company, was lighted during the month, and another furnace will be ready in about two or three months. It is anticipated that the production of iron at these works will now be greatly increased.

THE business of the Vauxhall Iron Works Company, Limited, of Luton, and 45, Leadenhall Street, London, E.C., and the West Hydraulic Engineering Company, of Luton, has been amalgamated. The name of the new concern will be the Vauxhall and West Hydraulic Engineering Company, Limited.

GRAHAM, MORTON & COMPANY, LIMITED, are reconstructing and widening the bridge over the Oxford Canal, near King's Sutton Station, and have also received the contract for the construction and erection of a second bridge over the railway near Chipping Norton Junction Station, both for the Great Western Railway.

THE UNBREAKABLE PULLEY AND MILL GEARING COMPANY, of West Gorton, Manchester, state that their Bristol agent, Mr. R. Stotesbury, has removed to more commodious premises in Temple Buildings, Victoria Street, where he holds a large stock of the firm's various specialities for the mechanical transmission of power.

MESSRS. EASTON & ANDERSON, of Broad Sanctuary Chambers, 20, Tothill Street,

Westminster, London, S.W., are the sole agents for Great Britain and the Colonies for the sale of the Huber apparatus for working the Brinell ball-pressure testing system, and all enquiries concerning this apparatus should be addressed to them.

THE directors of the Electric Railway and Tramway Carriage Works have decided to purchase the Castle Carriage Company and the British Electric Works, which are situated at Hadley, Shropshire, and Old Trafford, Manchester, for £58,000, from the Metropolitan Amalgamated Railway Carriage and Wagon Company, Birmingham.

RICHARDSON, WESTGARTH & COMPANY, LIMITED, have just completed for the Cargo Fleet Iron Company, Limited, the first of a pair of what are considered the largest rolling mill engines in the world. The engines are intended to drive the new 40-in. cogging mill at Cargo Fleet. They consist of a set of three-crank vertical compound engines of 15,000 h.p., having cylinders at 45-in. diameter and 52-in. stroke.

THE Naval Exhibition at Earl Court includes exhibits from several well-known engineering firms, such as Sir W. G. Armstrong, Whitworth & Company, Limited; Vickers, Sons & Maxim, Limited; John Brown & Company, Limited; Thorneycroft & Company; Siebe, Gorman & Company, Limited; Babcock & Wilcox, Limited; T. Firth & Sons; Princeps & Company; and William Beardmore & Company, Limited.

VICKERS, SONS & MAXIM, LIMITED, have just let contracts for further extensions at their works at Barrow-in-Furness so as to enable them to build the largest vessel yet designed. A new slipway is being constructed. The firm is also constructing a new fitting-up pier in the Buccleuch Dock, Barrow, at which the largest ships can be equipped with engines, boilers, and other appliances. Alongside of the pier a new 150-ton electric crane will be built.

J. BEARDSHAW & SONS, LIMITED, of the Baltic Steel Works, Sheffield, have issued particulars of various tests made with their H. V. Conqueror brand high-speed steel; also illustrations of the different sections of profiles which they have registered and patented, the advantage claimed being the saving in weight, in some cases, from 35 to 50 per cent. Thus, for instance, an 8 ft. bar of the fluted section weighs only 11½ lbs., as compared with 1 in. square 27 lbs.; others in proportion.

THE third International Electric Tramway and Railway Exhibition will be held at the Royal Agricultural Hall, London, N., from July 3 to July 14, 1905. The preliminary list of exhibitors includes Askham Brothers & Wilson, Limited; Babcock & Wilcox, Limited; Bayliss, Jones & Bayliss, Limited; Bennis & Company, Limited; Bergish Steel Foundry; British Griffin Company, Limited; Crossley Brothers, Limited; Graham, Morton & Company, Limited; Hadfield's Steel Foundry Company, Limited; Lancashire Dynamo and Motor Company, Limited; Lassen & Hjort; W. F. Mason, Limited; Meldrum Brothers, Limited; Jas. Proctor, Limited; Railway and General Engineering Company; Reavell & Company; Simplex Steel Conduit Company, Limited; Stirling Boiler Company, Limited; Sturtevant Engineering Company; Triumph Stoker, Limited; and the Underfeed Stoker Company, Limited.

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OBITUARY.

MR. G. SWAILES, of J. Swailes & Sons, Limited, of the Oldham Cop Tube Works, Oldham.

MR. BENJAMIN GILL, brassfounder, of Round Oak, Brierley Hill, at the age of 78 years.

MR. R. H. HOUSMAN, M.I.E.E., of Edgbaston, Birmingham, scientific adviser to Kynoch's, Limited.

MR. W. F. JONES, secretary of the Patent Nut and Bolt Company, Smethwick, at the age of 82.

MR. EDWARD GEM, who was very closely connected with the commercial life of Birmingham, in his 95th year.

MR. T. BELL, joint manager with Mr. J. Richardson, of Robey & Company, Limited, until a year ago, when he retired.

MR. E. HOSKYNS, departmental manager of the steel works of Cammell, Laird & Company, Limited, at Penistone, Sheffield.

MR. C. J. D. CHRISTIE, a director of Swan, Hunter, & Wigham Richardson, Limited, and Mr. R. Hudson, secretary to the company.

MR. ENOCH HORTON, of Horton & Son, Limited, nut and bolt manufacturers, Darlaston, and one of the oldest public men in the Black Country.

MR. P. U. ASKHAM, a member of the firm of Askham Brothers & Wilson, Limited, of the Yorkshire Steel and Engineering Works, Napier Street, Sheffield.

Mr. John Spencer, of John Spencer & Sons, Limited, Newburn Steel Works, Newcastle-on-Tyne, at the age of 87 years. The deceased gentleman was senior proprietor of the works.

Dr. Carl Lueg, head of the Gutehoffnungshutte, of Oberhausen, and a member of the boards of the Concordia Mining Company, the Schaaffhausen Bank Verein, and the Siemens' & Halske Electrical Company. He was also a member of the British Iron and Steel Institute.

Mr. C. Wallis, who, in 1864, with Mr. Jesse Collings, established the firm of Collings & Wallis, and subsequently acquired the well-known anvil and vice works of Peter Wright & Sons, Oldbury and Dudley.

Mr. Charles Cammell, who, up to about a year ago, was a director of Cammell, Laird & Company. Mr. Cammell, who was 57 years of age, was the eldest son of the late Mr. Charles Cammell, founder of the firm.

Mr. Charles Spencer, previously managing engineer at the Ebbw Vale Iron Works, manager at the Malleable Iron Works, Stockton, and manager of the West Stockton Iron Works, and latterly chief engineer of Messrs. John Hill & Company's Newport Iron Works, Middlesbrough.

Sir Benjamin Hingley, Bart., at the age of 75 years. The history of the concern of Messrs. Noah Hingley & Sons was one of continual expansion, the developments including the acquisition and building up of the businesses of the Old Hill Iron Works and Blast Furnaces, the Hart's Hill Iron Works, and numerous collieries.

The Right Hon. Sir Bernhard Samuelson, in his 85th year. As the chairman of Sir B. Samuelson & Company, of Middlesbrough, and of Samuelson & Company, Limited, of Banbury and Orleans, Sir Bernhard occupied a high position in the manufacturing world.

—o—

A printer's error occurred in our issue of April in an article on "Dartium Alloy," in which we state that an addition of 11 lbs., of dartium to 30 lbs. of malleable cast iron has increased the tensile strength 30 per cent. It should read thus: An addition of 1 lb. of dartium to 30 lbs. of malleable cast iron has increased the tensile strength 30 per cent.

COMPANY NEWS.

Henry Pooley & Son, Limited.—Preference dividend, 5½ per cent.; carry forward, £3,193.

Ruston, Proctor & Company, Limited.—Ordinary dividend, 6 per cent.; depreciation, £12,119; £5,708 carried forward.

Brush Electrical Engineering Company, Limited.—Gross annual profits, £71,280; preference dividend, 6 per cent.

Furness, Withy & Company, Limited.—Further ordinary dividend of 2½ per cent., making 5 per cent. for the year ended April 30.

The Bute Shipbuilding, Engineering & Dry Dock Company, Limited.—Ordinary dividend, 2½ per cent.; £24,613 16s. 5d. carried forward.

Wm. Simons & Company, Limited.—Preference dividend, 5 per cent. per annum; ordinary dividend, 10 per cent. per annum; £2,456 12s. 1d. carried forward.

Fletcher, Russell & Company, Limited.—Cumulative preference dividend, 6 per cent.; final dividend of 10 per cent. per annum, and a bonus of 1s. per share, making 15 per cent. for the year on the ordinary shares.

Parkgate Iron and Steel Company, Limited.—Gross profit for 1904, £36,081 2s. 10d.; ordinary dividend, 9d. per share, making a total of 1s. 3d. per share, or 7½ per cent. for the year; depreciation, etc., £12,000; carry forward, £12,590 3s. 7d.

—o—

CASTING CORLISS CYLINDERS.

To the Editor of the Foundry Trade Journal.

Sir,—In further reply to "Subscriber" *re* the above, his sketch fully indicates my meaning with respect to the halving of the pattern. If he will make himself gauges to suit various thicknesses, and set top and bottom cores to same, they will match correctly. The ports at each end are attached to steam and exhaust chambers on their respective sides, and the coring in halves means the entire group on either side. He need have no qualms as to results if he will follow my instructions, and I think he will admit, when he gets the correct hang of the operation, that it is quite as simple as it appeared to him at first sight.

Yours, etc.,

Chas. E. Allen.

Grantham, May 27, 1905.

ELDERS FOUNDRY COKE

As supplied to the British . . Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

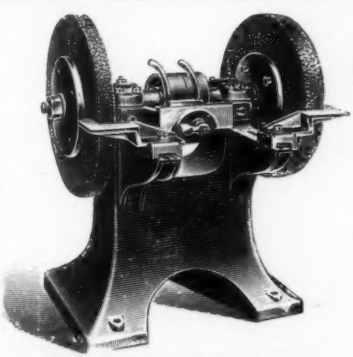
From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

Nearly Fifty Years' EXPERIENCE in the Manufacture of Grinding Machines.



"CD" TYPE, MEDIUM GRINDER.

Machines complete with EMERY or CORUNDUM WHEELS, from £2 to £60.

Mitchell's Emery Wheel Co.

MILL STREET, BRADFORD, MANCHESTER.

Also at LONDON, GLASGOW, and BELFAST.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS.	1904-5.	1903-4.
Iron—Scotch pig warrant ... ton	52/0	51/6
—Middlesbro' warrants ... ... ton	46/0	43/6
—W.C. M/nos Bessemer ... ... ton	58/0	55/6
—Stock, Scotch, May 27 ...tons	18,000	9,600
Copper—Chili bars, GMB ... ... ton	£64 15/0	£57 7/6
—Stock, Europe & afloat... ... tons	16,883	10 823
Tin—English ingots ton	£138	£124
—Straits ... ton	£137	£122 7 6
—Stock, Ldn. Hlnd and aflt ... tons	12,824	14,789
Lead—English pig ton	£13 2/6	£11 12/6
Spelter—Ord. Silesian ... ... ton	£23 12/6	£22 2/6
Quicksilver-(75lb.) bottle	£7 7/6	£8
Antimony—Regulus ... ... ton	£36 15 0	£29

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	7 0 0
Pipes, 1½ to 2½ in.	5 0 0	to	5 5 0
,, 3 to 4 in....	4 12 6	to	4 17 6
,, 5 to 8 in.	4 10 0	to	4 12 6
,, 10 to 16 in....	4 10 0	to	4 12 6
,, 18 to 24 in....	4 10 0	to	4 12 6
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 0 0	to	3 2 6

SCRAP.

The quotation for scrap subject to market fluctuations is as follows :—Engineers' heavy scrap, 50s. to 52s. 6d.; ditto light scrap, 20s. to 22s. 6d.; clean scrap brass, 37s. 6d.; clean scrap copper, 56s.; lead (usual draft), 11s. 3d.; tea lead, 10s. 3d.; zinc, 17s. 9d.; hollow pewter, 100s.; black pewter, 65s. per cwt.

THE ARDEER FOUNDRY COMPANY, of Stevenston, have acquired the works, etc. of the Ayrshire Foundry Company, Limited.

SILICA FIRE BRICK Co.,

OUGHTIBRIDGE.

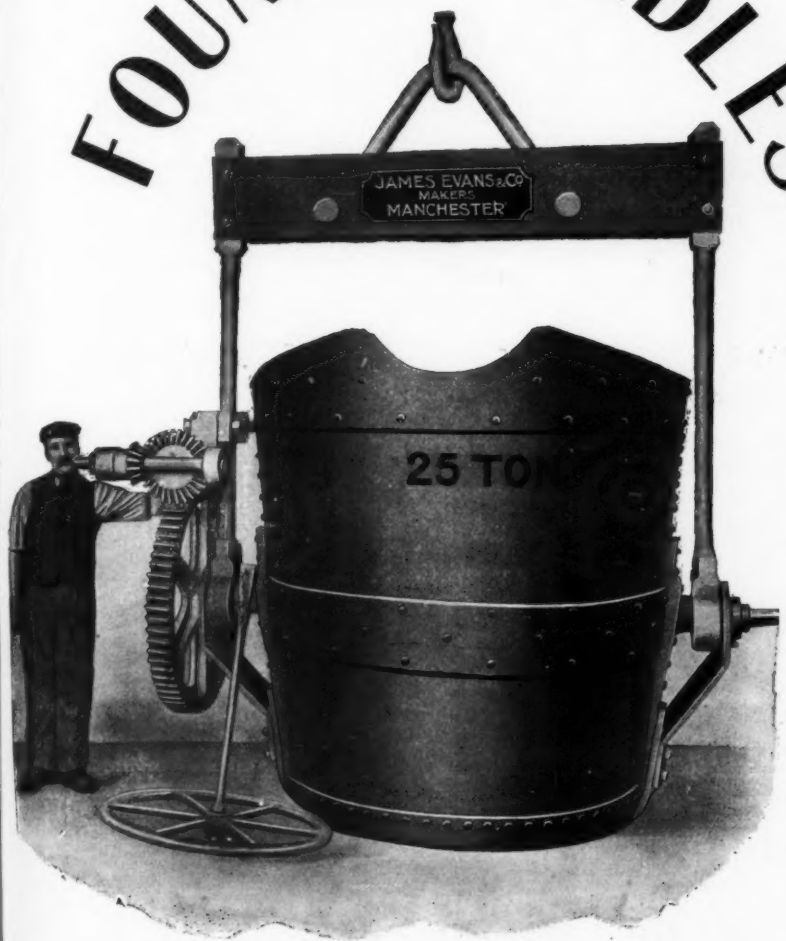
GROUND GANISTER,

Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Contractors to H.M. Government.

FOUNDRY LADLES

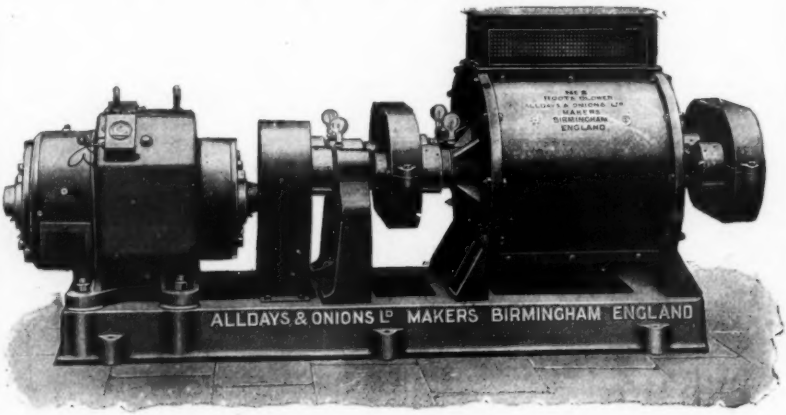


JAMES EVANS & Co., FOUNDRY ENGINEERS,

Telegrams:
"LADLES, MANCHESTER."

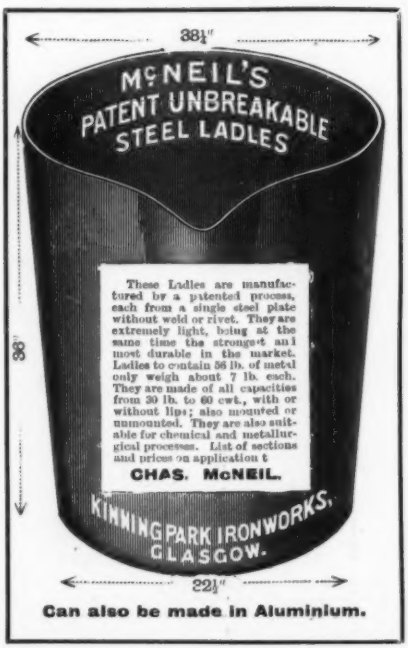
BRITANNIA WORKS, MANCHESTER.

ROOTS BLOWERS.



ALLDAYS & ONIONS PNEUMATIC ENGINEERING CO., LTD., BIRMINGHAM.

AND AT 20 BUCKLERSBURY, LONDON, E.C. Telegrams: "ALLDAYS, BIRMINGHAM."


38½"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application t
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW.
38"
22½"

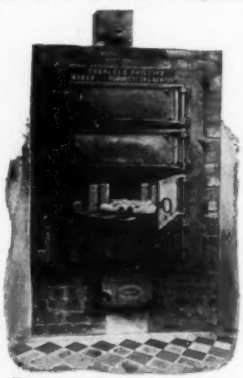
Can also be made in Aluminium.

CHARLES D. PHILLIPS'

Registered and Improved

Foundry Core Oven,

Indispensable in any Foundry using small Cores.



Registered No. 356,812.

OVEN BUILT IN WALL

4 Shelves, each 10 inches deep. Sizes: Front width, 3 ft. 6 in.; height, 4 ft. 8 in. Inside, width, 3 ft.; depth, 2 ft. 7 in.; height, 4 ft. 3 in.

Price, £12 10 0

CHARLES D. PHILLIPS,

Emlyn Iron Works, NEWPORT (Mon.).

HUB IS NOT THROWN AWAY

when our

ECONOMY BRUSH

is worn out, because you can place fresh layers of Steel Wire on it yourself.

Used on Emery Grinders, they are found invaluable for

CLEANING CASTINGS.

Many other uses are always being found for them.

THE SPECIAL WIRE DOES NOT LAY DOWN OR BREAK OFF.

SIZES, 15 INCHES DIAMETER DOWN TO 8 INCHES.

J.W.&C.J.PHILLIPS,

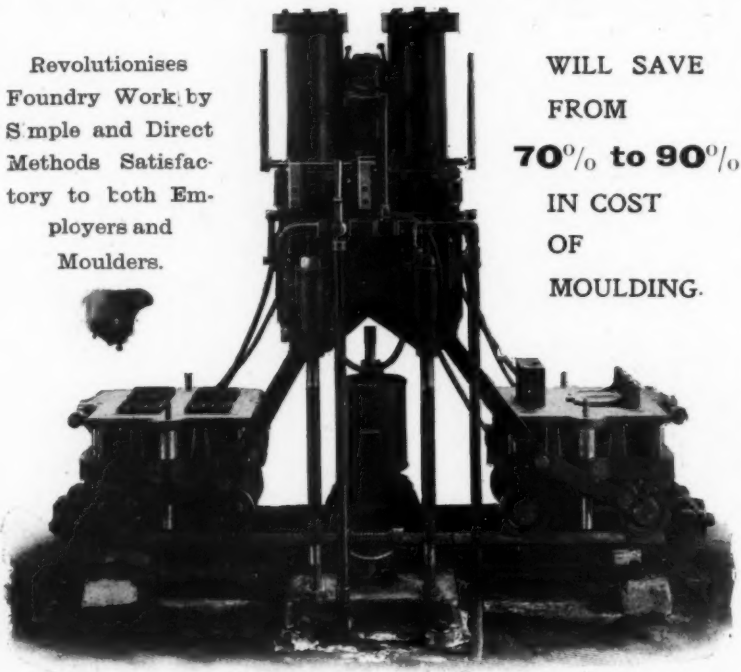
College Hill, London, Eng.

The McClelland Patent

SAND MOULDING MACHINE

Revolutionises Foundry Work by Simple and Direct Methods Satisfactory to both Employers and Moulders.

WILL SAVE FROM **70%** to **90%** IN COST OF MOULDING.



Type A.—Power Operated Carriage run under Rammer, Mould Rammed, Carriage Returned and Box Lifted, all Automatically. Arranged for one or two men to work continuously.

NO OTHER SAND MOULDING MACHINE HAS THE SPEED, SIMPLICITY AND STRENGTH OF THIS.

TURNS OUT BETTER MOULDS AND CASTINGS THAN BY HAND.

THE SAFETY TREAD SYNDICATE,

15, BARBICAN, LONDON, E.C.

Telephone, 5646 Bank. **Telegraph, "Unslipping," London.**

SITUATIONS VACANT AND WANTED.

MOULDER, Head Foreman, first-class Man Wanted, at once, to take charge of Moulding Shops in Iron Foundry; must be accustomed to both light and heavy work, and able to settle piecework prices; also to take charge of Furnaces and well up in the mixing of metals for all kinds of Engineer's Castings. —Apply, by letter, stating age, experience, salary, etc., to BOX 175, Offices of FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

FOREMAN MOULDER seeks engagement; 38; thoroughly practical and experienced in the production of all kinds of general light castings; up to date in foundry practice, cupolas, and iron mixing, handling men; good references.—Address Box 181, Offices of the FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

FOR SALE AND WANTED.

FOR SALE, "Root's" Patent and other Foundry Blowers.
No. 2A size by "Daglish," Glasgow, 4½ in. outlet
No. 1A ,, ,, "Allday," Birmingham, 6 in. ,,
No. 3 ,, ,, "Wilkinson's" Patent, 6 in. ,,
No. 5 ,, ,, "Thwaites" ,, 14¾ in. ,,
"Lloyd's" Patent Fan as new, 8 in. ,,
—For full details address J. LIGHT, Wolverhampton.

A FOUNDRY, in full work, TO LET, with all appliances on rent, or to be SOLD outright; or Foreman or Manager required, with salary and commission upon profits. Plenty of continuous work assured. Or with premises in the same works for Motor Car or other Engineering work. Present proprietor so much engaged in other businesses is desirous of making this a branch of his other many commercial undertakings. Question of capital no factor. Only principals dealt with.—Apply, for full particulars and district, to BOX 171, Offices of THE FOUNDRY TRADE JOURNAL.

FOR SALE AND WANTED.— *continued.*

CASTINGS. — For Good, Sound Machinery Castings, in Green or Dry Sand or Loam, up to 15 tons in weight, and Machined if required, apply to ROSE, DOWNS, AND THOMPSON, LTD., Old Foundry, Hull. Special Quotations for Quantities.

THE well-known FINE RED MOULDING SAND, for Iron, Brass, Aluminium, &c.—Apply MANSFIELD SAND CO., LTD, Mansfield, Notts.

CRUCIBLE STEEL CASTINGS for Collieries, Works, and Engineers, from customers' patterns; machined if desired.—P. T. WOODRUFF AND CO., Machen, Newport, Mon.

FIVE LATHES, length of beds 6 ft. to 27 ft.; Two Drilling Machines, One Planing Machine, One Shaping Machine, One Screwing Machine; Low Prices.—ATLANTIC WORKS COMPANY, Newport.

A POSTCARD
Will bring you a Specimen Copy of the
BRITISH MACHINERY GAZETTE
PUBLISHED MONTHLY.
And containing Offers of **10,000 LOTS** of New and Second-hand
MACHINERY OF ALL KINDS.
It will save you Time and Money.
BEANLAND, PERKIN & CO.,
North Eastern Works, LEEDS.

THE FOUNDRY TRADES
Will be interested to know that
JOHN MOODY, SON, & CO.,
HUDDERSFIELD,
Are Makers of
ELECTRIC, HIGH & LOW PRESSURE HYDRAULIC, and
POWER DRIVEN CUPOLA HOISTS & FOUNDRY CRANES.
WRITE FOR QUOTATIONS.

BLACK DELPH FIREBRICKS

For High Temperatures.

Also Special Grades for
CUPOLA LININGS, STEEL FURNACES,
BRASS FURNACES.

CRUCIBLE CLAYS.

E. J. & J. PEARSON, LTD.
STOURBRIDGE.

THE HELICAL CENTRIFUGAL PUMPS.

Wade and Cherry's Patent.

SOLE MANUFACTURERS AND PATENTEES, **John Cherry & Sons**

Pump Works, Beverley, Yorkshire.

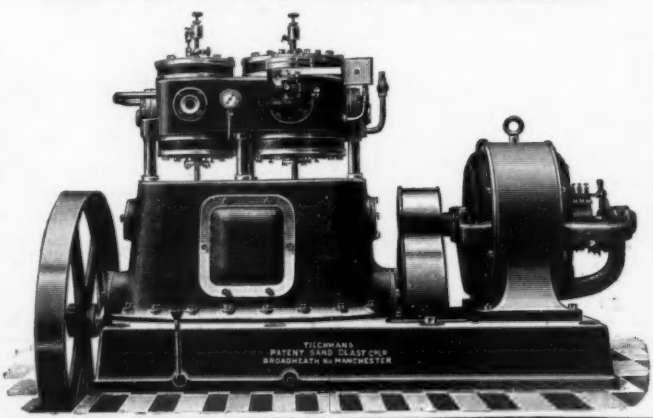
Tel. Address: "CHERRY, BEVERLEY."

Ganister, Cupola Blocks, Fire Bricks,
Fire Clay.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
Steel Moulders' Composition, Silica Cement.

J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

AIR COMPRESSORS
DRIVEN BY STEAM, BELT, OR ELECTRICITY.

HORIZONTAL & VERTICAL.
Single Stage & Compound Types



High efficiency, Silent working and 12 months guarantee.

SAND BLAST APPARATUS for cleaning large & small Castings, either steel, iron or gun metal.

Tilghman's Patent Sand Blast Company, Ltd.,
BROADHEATH, near MANCHESTER.

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High efficiency, Silent working